FINAL

BASELINE HUMAN HEALTH RISK ASSESSMENT
FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

PREPARED BY:

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FEBRUARY 8, 2010

9543560

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LIST OF ACRONYMS

AAF – absorption adjustment factor

ADD – average daily dose

AF – soil/sediment to skin adherence factor

$^{Air}Soil_{Inh\text{-}VP}$ – soil concentration that is protective of the air inhalation pathway

AST – aboveground storage tank

AT – averaging time

ATSDR – Agency for Toxic Substances and Disease Registry

BHHRA – Baseline Human Health Risk Assessment

BW – body weight (kg)

COC – chemical of concern

COI – chemicals of interest

CSF – cancer slope factor

CSM – conceptual site model

4,4'-DDD – dichlorodiphenyldichloroethylene

4,4'-DDT – dichlorodiphenyltrichloroethane

DQO – data quality objective

EA – exposure assessment

ED – exposure duration

EF – exposure frequency

EPA – United States Environmental Protection Agency

EPC – exposure point concentration

FI – fraction ingested

FSP – Field Sampling Plan

Ft. – feet

GRG – Gulfco Remediation Group

HI - hazard index

HQ – hazard quotient

IR – ingestion rate

IRIS – Integrated Risk Information System

IUR – inhalation unit risk

J&E VIM – Johnson & Ettinger Vapor Intrusion Model

Kg – kilogram

LIST OF ACRONYMS

KM – Kaplan-Meier

LADD – lifetime average daily dose

MDL – method detection limit

NEDR – Nature and Extent Data Report

NOAEL – no observable adverse effects level

NPL – National Priorities List

OSWER – Office of Solid Waste and Emergency Response

PBW – Pastor, Behling & Wheeler, LLC

PCB – polychlorinated biphenyl

PCL – Protective Concentration Limit

PCOC – potential chemical of concern

PPRTV – Provisional Peer Reviewed Toxicity Values

PSA – potential source area

PSV – preliminary screening value

QA – quality assurance

QAPP – Quality Assurance Project Plan

RfC – reference concentration

RfD – reference dose

RI – Remedial Investigation

RI/FS – Remedial Investigation/Feasibility Study

RME – reasonable maximum exposure

RSL – Regional Screening Level

SA – skin surface area

SOW – Statement of Work

^{SW}RBEL – risk-based exposure limit for surface water

TCEQ – Texas Commission on Environmental Quality

TDS – total dissolved solids

TDSHS – Texas Department of State Health Services

TRRP – Texas Risk Reduction Program

TSWQS – Texas Surface Water Quality Standard

UAO – Unilateral Administrative Order

UCL – upper confidence limit

VOC – volatile organic compound

EXECUTIVE SUMMARY

The purpose and scope of this document is to summarize the analytical data for environmental media sampled during the Remedial Investigation (RI) and to conduct a baseline human health risk assessment (BHHRA) based on those data for the Gulfco Marine Maintenance Superfund Site located at 906 Marlin Avenue in Freeport, Texas in Brazoria County (the Site). A BHHRA is the systematic, scientific characterization of potential adverse effects resulting from exposures to hazardous agents or situations. The results of the BHHRA are used to support risk management decisions and determine if remediation or further action is warranted at a site.

The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west. Beginning in approximately 1971, barges were brought to the facility and cleaned of waste oils, caustics and organic chemicals, with these products reportedly stored in on-site tanks and later sold. Sandblasting and other barge repair/refurbishing activities also reportedly occurred on the Site. During the operation, wash waters were reportedly stored either on a floating barge, in on-site storage tanks, and/or in surface impoundments present on Lot 56 of the Site. The surface impoundments were closed under the Texas Water Commission's direction in 1982.

The area of the Site south of Marlin Avenue (South Area) includes approximately 20 acres of upland that were created from dredged material from the Intracoastal Waterway. Prior to construction of the Intracoastal Waterway, this area was most likely coastal wetlands. The area of the Site north of Marlin Avenue (North Area), excluding the capped surface impoundments and access roads, is considered estuarine wetland. The North Area consists of approximately five acres of upland, which supports a variety of herbaceous vegetation that is tolerant of drier soil conditions, while the North Area wetlands are approximately 15 acres in size.

Data related to the nature and extent of potential contamination in environmental media (e.g., soil, sediment, groundwater and surface water) at the Site were obtained as part of the RI. Unless otherwise noted, the samples were analyzed for the full suite of analytes as specified in the approved Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Site. Samples included:

- Eighty-three surface soil samples (0 to 0.5 ft below ground surface) and 83 subsurface soil samples (0.5 ft to 4 ft below ground surface) were collected in the South Area.

- Eighteen surface soil and subsurface soil samples were collected in the North Area.
- Two additional surface soil samples were collected near the former transformer shed at the South Area for polychlorinated biphenyls (PCBs) analyses only.
- Ten background soil samples were collected within the approved background area approximately 2,000 feet east of the Site near the east end of Marlin Avenue.
- Thirteen groundwater samples were collected from the shallow Zone A groundwater from the South Area and sixteen groundwater samples were collected from the shallow Zone A groundwater from the North Area.
- Sixteen sediment samples were collected from the Intracoastal Waterway in front of the Site. One additional sediment sample was collected near the Site and analyzed for 4,4'-DDT.
- Nine background sediment samples were collected from the Intracoastal Waterway east of the Site and across the main waterway canal.
- Forty-eight sediment samples were collected in the North Area wetlands. Additional sediment samples were collected from the North Area wetlands and analyzed for 4,4'-DDT; five of these samples were also analyzed for zinc.
- Eight sediment samples were collected from the two ponds located in the North Area.
- Four surface water samples were collected in the Intracoastal Waterway adjacent to the Site.
- Four surface water samples were collected from the background surface water area.
- Four surface water samples were collected in the North Area wetlands.
- Six surface water samples were collected from the two ponds located in the North Area.

All data were compared to appropriate human health screening levels (multiplied by a factor of 0.1 to ensure adequate protection) to identify the potential chemicals of concern (PCOCs) that were quantitatively evaluated further in the BHHRA. The exposure assessment was developed using information about current land, surface water, and groundwater uses to identify reasonably anticipated current and future receptors. For each receptor, potential exposure pathways were identified and considered fate and transport of the chemicals in the environment, point of contact with the exposure media, and possible routes of intake.

Based on the exposure assessment, it was assumed that potentially exposed populations for the South Area included: 1) future commercial/industrial workers; 2) future construction workers; and 3) a youth trespasser. Potentially exposed populations for the North Area were assumed to be the same. A contact recreation scenario was assessed for the sediment and surface water at both areas to represent the hypothetical person who occasionally contacts these media while swimming wading, or participating in

other recreational activities. Potential impacts from fugitive dust generation and volatile compound emissions from South and North Area soils, and subsequent exposure to nearby residents was also evaluated. A previous report submitted to and approved by EPA evaluated the potential risks to recreational anglers via the consumption of fish from the Intracoastal Waterway. The findings of that evaluation are also included in the BHHRA.

Chemical exposure was quantified by estimating a daily dose or intake for each pathway given standard exposure assumptions using average and a reasonable maximum exposure concentration, which was generally represented by a 95th percent upper confidence limit on the mean. Toxicity values for the chemicals of concern were obtained from standard resources such as EPA's on-line database -- Integrated Risk Information System (IRIS).

Risk characterization is the integration of the exposure estimate (or dose) and the toxicity information to make quantitative estimates and/or qualitative statements regarding potential risk to human health. The risk assessment concluded that, for the five different exposure scenarios that were quantitatively evaluated, the cancer risk estimates and noncancer hazard indices for all of the current or future exposure scenarios were within EPA's acceptable risk range or below the target hazard index of 1with the exception of potential risks associated with future exposure to an indoor industrial worker if a building is constructed over the area of impacted groundwater in the North Area. It is recommended that the potential future exposure to workers in an enclosed space (if a building were constructed above the groundwater plume in the North Area) from vapors possibly emanating from groundwater and migrating to the indoor air be prevented. No further action or investigation is necessary for the other media at the Site since adverse risks are not expected to result from potential current or future exposure at the Site.

1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. (the Site) in Freeport, Brazoria County, Texas to the National Priorities List (NPL) in May 2003. The EPA issued a modified Unilateral Administrative Order (UAO), effective July 29, 2005, which was subsequently amended effective January 31, 2008. The UAO required the Respondents to conduct a RI/FS for the Site. The Statement of Work (SOW) for the RI/FS at the Site, provided as an Attachment to the UAO from the EPA, requires the performance of a BHHRA to "evaluate and assess the risk to human health posed by the contaminants present at the Site." As specified in Paragraph 37a of the SOW, BHHRA activities include the submittal of Draft and Final Potential Chemicals of Concern Memoranda and Draft and Final Exposure Assessment (EA) Memoranda, ending with a Draft and Final BHHRA. In order to expedite completion of the RI/FS through submittal of a single BHHRA deliverable, the interim BHHRA deliverables (i.e., the PCOC and EA Memoranda) have been incorporated in this BHHRA.

Pursuant to Paragraphs 17 through 28 of the SOW, an RI/FS Work Plan and a Sampling and Analysis Plan were prepared for the Site. These documents were approved with modifications by EPA on May 4, 2006 and were finalized on May 16, 2006. This BHHRA has been prepared in accordance with Section 5.7.1 of the approved RI/FS Work Plan (the Work Plan) (PBW, 2006a). The BHHRA was prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy), and The Dow Chemical Company (Dow), collectively, the Gulfco Restoration Group (GRG).

A BHHRA is the systematic, scientific characterization of potential adverse effects resulting from exposures to hazardous agents or situations (NRC, 1983). The results of the BHHRA are used to support risk management decisions and determine if remediation or further action is warranted at a site.

The RI/FS is the methodology that the Superfund program has established for characterizing the nature and extent of risks posed by uncontrolled hazardous wastes sites and for developing and evaluating remedial options. The risk assessment methodology is based on approaches described by the EPA in *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual, Part A* (EPA, 1989) and various supplemental and associated guidance (e.g., EPA, 1986; 1991a and b; 1992a and b; 1997a; 1999; 2001; 2002a, and b; 2004a and b; 2008; and 2009). The BHHRA generally consists of the following components:

- Review of analytical data and identification of potential chemicals of concern or PCOCs;
- Exposure assessment, including identification of potentially exposed populations, exposure pathways, and chemical intakes;
- Human health toxicity assessment;
- Risk characterization; and
- Uncertainty analysis.

The Nature and Extent Data Report (NEDR) (PBW, 2009) describes the history and background of the Site, and the environmental investigations conducted during the various phases of the RI. It also includes all of the analytical data generated during the RI and a discussion of the environmental conditions at the Site.

Section 2.0 of the BHHRA describes the process for evaluating the data and selecting PCOCs. Section 3.0 provides the exposure assessment. The toxicity assessment is contained in Section 4.0. Risks are characterized in Section 5.0. Section 6.0 describes uncertainties associated with the risk assessment process. Section 7.0 presents the conclusions of the risk assessment. Appendix A provides statistical calculations for the analytical data, by media; Appendix B provides the statistical comparisons between Site data and background data; Appendix C provides the intake calculations for the receptors evaluated herein; Appendix D provides the risk calculations; and Appendix E provides a copy of the restrictive covenants for the Site.

1.1 SITE LOCATION AND HISTORY

The Site is located northeast of Freeport, Texas in Brazoria County at 906 Marlin Avenue (also referred to as County Road 756). The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west. Figure 1 provides a map of the Site vicinity; Plate 1 provides a detailed Site map and shows site features and sampling locations.

During the 1960s, the Site was used for occasional welding but there were no on-site structures (Losack, 2005). According to the Hazard Ranking Score Documentation (TNRCC, 2002), from 1971 through 1999, at least three different owners used the Site as a barge cleaning facility. Beginning in approximately 1971, barges were brought to the facility and cleaned of waste oils, caustics and organic chemicals, with these products reportedly stored in on-site tanks and later sold (TNRCC, 2002). Sandblasting and other barge repair/refurbishing activities also occurred on the Site. At times during the operation, wash waters were reportedly stored either on a floating barge, in on-site storage tanks, and/or in surface impoundments on Lot 56 of the Site. The surface impoundments were closed under the Texas Water Commission's (Texas Commission on Environmental Quality (TCEQ) predecessor agency) direction in 1982 (Carden, 1982).

Marlin Avenue divides the Site into two areas. For the purposes of this report, it is assumed that Marlin Avenue runs due west to east. The property to the north of Marlin Avenue (the North Area) consists of undeveloped land and the closed impoundments, while the property south of Marlin Avenue (the South Area) was developed for industrial uses with multiple structures, a dry dock, sand blasting areas, an aboveground storage tank (AST) tank farm that is situated on a concrete pad with a berm, and two barge slips connected to the Intracoastal Waterway.

The South Area is zoned as "W-3, Waterfront Heavy" by the City of Freeport. This designation provides for commercial and industrial land use, primarily port, harbor, or marine-related activities. The North Area is zoned as "M-2, Heavy Manufacturing." Restrictive covenants prohibiting any land use other than commercial/industrial and prohibiting groundwater use have been filed for all parcels within both the North and South Areas. Additional restrictions requiring any building design to preclude vapor intrusion have been filed for Lots 55, 56, and 57. A further restriction requiring EPA and TCEQ notification prior to any building construction has also been filed for Lot 55, 56, and 57. Copies of these covenants, including parcel maps with the specific Lot identified, are provided in Appendix E.

Adjacent property to the north, west and east of North Area is unused and undeveloped, and/or is designated as wetlands as shown in Figure 2. Adjacent property to the east of the South Area is currently used for industrial purposes while the property directly to the west of the Site is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south. Residential areas are located south of Marlin Avenue, approximately 300 feet west of the Site, and 1,000 feet east of the Site.

1.2 ENVIRONMENTAL SETTING

The Site is located between Galveston and Matagorda Bays and is situated along approximately 1200 feet (ft.) of shoreline on the Intracoastal Waterway. The Intracoastal Waterway is a coastal shipping canal that extends from Port Isabel to West Orange on the Texas Gulf Coast and is a vital corridor for the shipment of bulk materials and chemicals. It is the third busiest shipping canal in the United States, and along the Texas coast carries an average of 60 to 90 million tons of cargo each year (TxDOT, 2001). Of the cargo carried between Galveston and Corpus Christi, TX, 49 percent is comprised of petroleum and petroleum products and 38 percent is comprised of chemicals and related products. Approximately 50,000 trips were made by vessels making the passage through the Intracoastal Waterway between Galveston and Corpus Christi, TX in 2006 (USACE, 2006).

The South Area includes approximately 20 acres of upland that were created from dredged material from the Intracoastal Waterway. Prior to construction of the Intracoastal Waterway, this area was most likely coastal wetlands. The North Area, excluding the capped impoundments, the uplands area, and access roads, is considered estuarine wetland (USFWS, 2008), as shown in Figure 2. The North Area consists of approximately five acres of upland, which supports a variety of herbaceous vegetation that is tolerant of drier soil conditions, while the North Area wetlands are approximately 15 acres in size. The wetlands at the Site are typical of irregularly flooded tidal marshes of the Texas Gulf Coast and supports wildlife that would be common in the Texas coastal marsh.

There are two ponds on the North Area, located east of the former surface impoundments (Plate 1). The larger of the two ponds is called the Fresh Water Pond while the other pond is referred to as the Small Pond. It should be noted, however, that based on field measurements of salinity, the water in the Fresh Water Pond is brackish while water in the Small Pond is less brackish (but is not fresh water). The Fresh Water Pond is believed to be a borrow pit and the water depth is generally 4 to 4.5 feet. The Small Pond is a shallow depression that tends to dry out during summer months and periods of drought. The water depth in the Small Pond was approximately 0.2 feet when sampled in July 2006 and nearly dry when sampled in June 2008.

The Intracoastal Waterway supports barge traffic and other boating activities. Fishermen have occasionally been observed on and near the Site in the Intracoastal Waterway. Red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), spotted seatrout (*Cynoscion nebulosus*), southern flounder (*Paralichthys lethostigma*) and other species are reportedly caught in the Freeport Area (TPWD, 2009). It should be noted that, during the fish sampling conducted for the human health fish ingestion pathway risk

assessment, red drum were not caught (using nets) as frequently as other species (see discussion in NEDR (PBW, 2009)), presumably because of a lack of habitat and prey items near the Site. Recreational and commercial fishermen reportedly collect blue crabs (*Callinectes sapidus*) from waterways in the region. The Texas Department of State Health Services (TDSHS) has banned the collection of oysters from this area due to biological hazards and has issued a consumption advisory for king mackerel for the entire Gulf Coast due to mercury levels in the fish (TDSHS, 2005).

2.0 DATA EVALUATION AND IDENTIFICATION OF POTENTIAL CHEMICALS OF CONCERN

This section describes the general data evaluation procedures that were used to ensure that data included in the risk assessment are of sufficient quality for quantitative risk assessment, as per EPA (1992a) guidance. This section also presents the methods that were followed to identify PCOCs for applicable exposure media in the BHHRA. Data collected as part of the RI were collected to support three objectives: nature and extent evaluation, risk assessment, and evaluation of potential remedial alternatives. The NEDR (PBW, 2009) discusses data collected to define the nature and extent of contamination at the Site and may contain data that are not of concern from a human health exposure perspective (e.g., Zone B and Zone C groundwater due to high total dissolved solids concentration and restrictive covenants precluding Site groundwater use (Appendix E)).

For the purposes of this risk assessment, a chemical of interest (COI) is defined as any compound detected in at least one environmental sample. A PCOC is any compound that does not get eliminated from further consideration based on frequency of detection, evaluation with blank contamination or background concentrations, and a concentration-toxicity screen, described in this section. PCOCs are quantitatively evaluated in the risk assessment. A chemical of concern (COC) is a compound that is determined as part of the risk assessment to present a potential adverse human health risk and will be evaluated further in the Feasibility Study, if necessary.

Data related to the nature and extent of potential contamination at the Site were obtained as part of the RI and, as noted previously, are discussed in the NEDR (PBW, 2009). Unless otherwise noted, the samples were analyzed for the full suite of analytes as specified in the approved Work Plan (PBW, 2006a). Plate 1 provides sample locations for site-related samples, and Figure 3 provides sample locations for the background soil, surface water, and sediment samples. Tables 1 through 15 summarize the key parameters for the COIs measured in these samples and provide maximum and minimum measured concentrations, as well as summary statistics for each COI for each media. Average and 95% upper confidence limits (95% UCLs) on the mean were estimated using EPA guidance (EPA, 2002b) and are presented in the tables as well. The method for estimating the average and 95% UCLs is described in greater detail in the Section 3.4.

Eighty-three surface soil samples (0 to 0.5 ft below ground surface (bgs)) and 83 subsurface soil samples (0.5 ft to 4 ft bgs) were collected in the South Area (summarized in Tables 1 and 2). Eighteen surface soil samples and 18 subsurface soil samples were collected in the North Area (summarized in Tables 8 and 9).

Two additional surface soil samples were collected near the former transformer shed at the South Area for PCBs analyses only. Ten background soil samples were collected within the approved background area approximately 2,000 feet east of the Site near the east end of Marlin Avenue (summarized in Table 15; sample locations shown on Figure 3).

Thirteen groundwater samples were collected from Zone A in the South Area (summarized in Table 3) and sixteen groundwater samples were collected from Zone A in the North Area (summarized in Table 10). The groundwater investigation evaluated contamination in deeper zones, Zones B and C. This information is discussed in the NEDR (PBW, 2009) but was not included in the BHHRA since it is unlikely that contaminants in deeper groundwater affect the media evaluated in the risk assessment based on high total dissolved solids (TDS) and the restrictive covenants on the property (Appendix E). While groundwater data from Zone A were used to evaluated the vapor intrusion pathway, data from Zones B and C were not used in this evaluation since they underlie Zone A and are COIs measured in deeper groundwater would not be as likely to impact indoor air as COIs measured in the more shallow groundwater unit, Zone A.

Sixteen sediment samples were collected from the Intracoastal Waterway in front of the Site (summarized in Table 6). One additional sediment sample was collected from the Intracoastal Waterway near the Site and analyzed for 4,4'-DDT to further characterize the extent of contamination as described in the NEDR (PBW, 2009). Nine background sediment samples were collected from the Intracoastal Waterway east of the Site and across the canal (summarized in Table 7). Forty-eight sediment samples were collected in the North Area wetlands (summarized in Table 13). Seven additional sediment samples were collected from the North Area wetlands and analyzed for 4,4'-DDT; five of these samples were also analyzed for zinc. A total of eight sediment samples were collected from the two ponds located in the North Area (summarized in Table 14).

Four surface water samples were collected in the Intracoastal Waterway adjacent to the Site (summarized in Table 4). Four surface water samples were collected from the background surface water area, located in the Intracoastal Waterway east of the Site, and across the canal (summarized in Table 5; sampling locations shown on Figure 3). Four surface water samples were collected in the wetlands drainage areas north of Marlin Avenue (summarized in Table 11) and a total of six surface water samples were collected from the two ponds located in the North Area (summarized in Table 12). Chemical analyses of these surface water samples included both total and dissolved concentrations of metals. For the purposes of the BHHRA, total concentrations were used since it is unlikely that samples would be filtered prior to incidental exposure as defined by the scenarios evaluated in this risk assessment.

2.1 DATA EVALUATION

The Quality Assurance Project Plan (QAPP) (PBW, 2006c) and Field Sampling Plan (FSP) (PBW, 2006b), which were developed concurrently with the RI/FS Work Plan (PBW, 2006a), were designed to ensure that the data collected during the RI are appropriate for quantitative risk assessment. After RI data collection, the existing data and RI data were subject to a data evaluation following procedures recommended by EPA (1992a) to ensure that these data are of adequate quality for quantitative risk assessment and to support risk management decisions. These include consideration of the following factors: data sources, completeness of documentation, adequacy of detection limits, and "data quality indicators" as defined by the EPA (1992a) guidance. The data quality indicators include: 1) sampling completeness; 2) representativeness of sampling locations for relevant exposure areas; 3) usability indicated by data validation results (including considerations of laboratory precision and accuracy); and 4) comparability of data analyzed by different methods. Data representativeness is one of the most important criteria when selecting data for use in the quantitative risk assessment. Representativeness is the extent to which data characterize potential exposure and hence risks to human health and the environment. Data selected for use in the quantitative risk assessment should be of overall high quality, and data validation should confirm that the data collected during the RI are of adequate quality for risk assessment.

Data validation was performed following the procedures set forth in the RI/FS Work Plan (PBW, 2006a) and the QAPP (PBW, 2006c). Results of the data evaluation and validation for the BHHRA data set are summarized as follows:

- Data Sources – All BHHRA data were generated using rigorous analytical methods (i.e., EPA-approved methods) by a single analytical laboratory with a documented quality system (i.e., accredited under the National Environmental Laboratory Accreditation Program). Historical data was not used for the BHHRA.

- Completeness of Documentation – Field sampling activities were documented on field data sheets. Sample custody was documented to maintain security and show control during transfer of samples. Analytical results were reported in laboratory data packages containing all information necessary for the data validation.

- Adequacy of Detection Limits – The QAPP specifies target Method Detection Limits (MDL), which were established based on the laboratory's capabilities and are less than the human health

Preliminary Screening Value (PSV), where possible, based on the standard available method with the lowest possible MDL. The MDL, as reported by the laboratory, for all constituents is at or below the target MDL or the human health PSV for the BHHRA data set except for 3,3'-dichlorobenzidine in the four Phase 2 surface water samples and benzidine in the seventeen Phase 2 sediment samples, one Phase 3 sediment sample, and four Pahse 4 sediment samples. (For Phase 1, the sample detection limits, or SDLs, are below the target MDLs for both of these constituents. Benzidine was not detected in any sample from the Site and 3,3'-dichlorobenzidine was only detected in a one sediment sample from the Site.)

- Data Quality Indicators
    - Sampling Completeness – The percentage of environmental samples collected versus that planned is 100% for samples critical to the BHHRA and is greater than the QAPP goal of 90% for every media and test except chromium VI. Chromium VI analyses were not performed for most of the Phase 1 sediments and all of the Phase 1 soils. However, there is no effect on usability for the BHHRA data set since total chromium, which includes any chromium VI, is reported for all samples.
    - Representativeness of Sampling Locations – Phase 1 samples were collected in accordance with the sampling plan presented in the FSP (PBW, 2006b), which was designed to meet the Data Quality Objectives (DQOs) detailed in the QAPP (PBW, 2006c), and additional samples were collected as needed based on the results of the initial sampling event. All samples were properly located and collected using approved standard operating procedures. As described in the RI/FS Work Plan (PBW, 2006a), it was decided that the majority of the soil and sediment sampling would be conducted on a random grid basis with some focused sampling in areas of known historical use. This type of sampling program is appropriate for estimating risks since human health exposure generally occurs randomly over a site, or a portion of a site. Plate 1 shows locations of soil, surface water, sediment and groundwater samples.
    - Data Validation Results – All data were validated using an approved standard operating procedure (Appendix F in the QAPP) based on the EPA *National Functional Guidelines* for organics and inorganics, respectively (EPA, 1999 and 2002c). A Level III validation including all quality control (QC) checks such as spike recovery, duplicate precision, blanks, holding time, calibration, surrogates, and internal standards was completed for 100% of the samples. Additionally, a Level IV validation that included examination of the raw data was completed for 10% of the soil, sediment, and surface water samples as stipulated in the QAPP. If a QC deficiency was found, sample results were flagged as

estimated (with expected direction of bias, where possible), blank-affected (due to contamination in an associated field or laboratory blank), or rejected (due to a major QC deficiency).

- Comparability of Data – Data were generated using the same analytical method for each constituent except naphthalene. Naphthalene was analyzed using SW-846 Method 8260B for all samples but four groundwater samples, which were analyzed using SW-846 Method 8270C. Both methods are rigorous analytical methods performed by a fixed analytical laboratory with a documented quality system meeting stringent QC requirements (unless qualified as rejected) and thus are comparable. All sample results are in standardized units of measure with dry-weight correction for soils and sediments.

As per EPA (1989 and 1992a), validated data qualified as J (estimated) and U (blank-affected) are included in the risk assessment. For quantitative purposes, when a compound was not detected or was blank-affected, one-half of the sample quantitation limit (as defined by the U.S. EPA (1992a)) was used as a proxy to provide a measurement for analysis. Only those data that were rejected (i.e., qualified as "R") were not included in the quantitative risk assessment. As indicated in the RI/FS Work Plan (PBW, 2006a), once the data collection, chemical analysis, and data evaluation/validation were complete, the data were analyzed to identify COIs for the human health risk assessment. The following section describes the process for determining whether a COI became a PCOC and was evaluated further in the BHHRA.

2.2 IDENTIFICATION OF POTENTIAL CHEMICALS OF CONCERN

EPA guidance (EPA, 1989) recommends considering several steps to eliminate compounds from further evaluation and, as such, this section describes the process used to reduce the list of chemicals evaluated in the BHHRA. Compounds were eliminated from further consideration if: 1) they were detected infrequently in a given media (i.e., in less than five percent of the samples); 2) they were measured at similar concentrations in blank samples; 3) they were detected at a low concentration (below one tenth of the screening value discussed below); or 4) they were measured at similar concentrations in background samples.

All analytes detected in at least one sample above the detection limit (including "J-flagged" data) were initially reviewed. If a compound was detected in less than five percent of the samples, the compound was eliminated from further evaluation for that media. This step was only considered in media where

twenty or more samples were collected and if that compound was not present in another media. The lab did not report any blank contamination issues with the data so no compounds were eliminated based on this criterion.

The data for soil, groundwater, surface water, and sediment are summarized in Tables 1 through 15. These tables show the frequency of detection, minimum, maximum, and average concentration for each COI. The 95% UCL on the mean concentration was calculated as described in Section 3. Appendix A provides the statistical calculations for these data.

2.2.1 Concentration-Toxicity Screen

A "concentration-toxicity screen" step, as recommended by EPA (EPA, 1989), was conducted to limit the number of chemicals that were included in a quantitative risk assessment while also ensuring that all chemicals that might contribute significantly to the overall risk were addressed. The screening values used were $1/10^{th}$ of the human health criteria, which were the lower of the EPA or TCEQ human health values as presented in the NEDR (PBW, 2009) for soil, surface water, and sediment. (It should be noted that NEDR tables also included ecological criteria and background values.) These screening criteria were compared to the maximum measured Site concentration and those compounds measured in Site samples in excess of the screening criteria (if any) have been denoted in bold on Tables 1, 2, 4, 6, 8, 9, 11, 12, 13, and 14. Because there are no readily available screening levels appropriate for the complete groundwater pathway at the Site, all chemicals of interest for groundwater media (Tables 3 and 10) were quantitatively evaluated in the risk assessment. It should be noted that if a compound was measured in more than five percent of the samples but a screening level was not available, it was retained for further evaluation in the BHHRA (eg., iron in sediment).

A similar screen was conducted for media collected at the background areas (Tables 5, 7, and 15), but this was done merely for comparative purposes. Risks associated with background concentrations were not calculated in the BHHRA.

In addition, PCOC concentrations in soil samples from the South Area and North Area were compared to TCEQ's Protective Concentration Levels (PCLs) that were developed to evaluate exposure to air emissions from particulate dust and volatile organic compounds (VOCs) emitted from contaminated soil ($^{Air}Soil_{InhV-P}$) in order to assess potential impacts from air emissions to nearby off-site residents. This approach is conservative since diluting effects of off-site migration and dispersion were not considered.

Aroclor-1254 and naphthalene were detected in South Area soil at a concentration greater than $1/10^{th}$ of the screening criteria, as shown in Tables 16, while no COIs were measured in North Area soil at a concentration greater than $1/10^{th}$ of the screening criteria, as shown in Table 17. While two compounds were measured at a concentration greater than $1/10^{th}$ of the screening criteria, it is unlikely that there is a potentially unacceptable risk since no attenuation was assumed for migration and dispersion, and because neither the average nor 95% UCL for these compounds exceed the screening criteria. Since this pathway was the only exposure pathway for the off-Site resident and because the screening evaluation shows no likelihood of adverse risk, this potential receptor was eliminated from further evaluation in the BHHRA. It should be noted, however, that inhalation of particulate dust and VOCs in soil at the South Area and North Area was evaluated for the industrial worker, construction worker, and youth trespasser scenarios as discussed in Section 3.0.

Exposure and risk calculations were not estimated for the surface water pathway in the Intracoastal Waterway and Wetlands Area because none of the measured maximum COI concentrations exceeded $1/10^{th}$ of their respective TCEQ's contact recreation PCL. These PCLs were developed for a child exposure scenario for noncarcinogenic compounds, and an age-adjusted scenario for carcinogenic compounds. The PCL is based on incidental ingestion and dermal contact of surface water while swimming for three hours, 39 times per year. It is believed that this is a bounding estimate for the Intracoastal Waterway, surface water north of Marlin Ave., and the ponds north of Marlin Ave. since none of these surface water bodies are very favorable for swimming and true exposure is likely to be much less than the scenario described by the Texas Risk Reduction Program's (TRRP) contact recreation PCL. All surface water concentrations were well below $1/10^{th}$ of the PCL for the Intracoastal Waterway and wetlands area surface water. Maximum measured concentrations of arsenic and thallium in the pond samples exceeded $1/10^{th}$ of their respective PCL but did not exceed the PCL and, therefore, neither were retained for further evaluation. Although TCEQ does not provide a PCL for iron, one was calculated using the contact recreation assumptions (TCEQ, 2006). Measured concentrations of iron in surface water were well below the calculated contact recreation PCL of 2,800 mg/L. Therefore, it was concluded that chemical concentrations of COIs in surface water samples from the Intracoastal Waterway near the Site, surface water in the North Area wetlands, and surface water in the North Area ponds do not pose an unacceptable health risk and chemical concentrations in these media were not evaluated further in the BHHRA.

In a response to EPA comments on the Draft BHHRA (EPA, 2010), Texas Surface Water Quality Standards (TSWQS) saltwater fish criteria (specifically the ^{SW}RBELs) were compared to measured concentrations of COIs in Intracoastal Waterway surface water (Table 4), Intracoastal Waterway

Background surface water (Table 5), wetlands surface water (Table 11), and Pond surface water (Table 12). The saltwater fish criteria represents a screening concentration in water that, above this level, may adversely impact humans eating fish caught in a given water body. The comments (EPA, 2010) requested that the Intracoastal Waterway and wetlands surface water be considered sustainable fisheries and measured concentrations in these media be compared with the TSWQS saltwater fish criteria, while the ponds be considered incidental fisheries, which allowed a factor of ten to be multiplied by the criteria prior to comparison with the site data.

No COIs were measured above the saltwater fish criteria in the surface water samples from the Intracoastal Waterway near the Site (Table 4). 4,4'-DDD, 4,4'-DDT, aldrin, and benzo(k)fluoranthene were detected in at least one surface water sample collected from the background area of the Intracoastal Waterway at concentrations above the saltwater fish criteria (Table 5). Total manganese and mercury concentrations was reported in at least one surface water sample collected from the wetlands area at levels above the saltwater fish criteria (Table 11). Dissolved manganese was measured in at least one surface water sampled collected from the wetlands area at a level above the saltwater fish criteria (Table 11). Total arsenic, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and thallium were measured in at least one surface water sample collected from the ponds at a concentration above the saltwater fish criteria for an incidental fishery (Table 12). Dissolved manganese was measured in at least one surface water sample collected from the ponds at a concentration above the saltwater fish criteria (Table 12).

Although the above TSWQS comparisons noted a few exceedences in the wetland and pond surface water samples, it is unlikely that there are consumable or desirable fish in these waters. The Small Pond is a shallow depression (on the order of a few inches deep) that often becomes dry during summer months and periods of drought. The Fresh Water Pond is believed to be a borrow pit with little vegetation and, thus, minimal habitat for fish. During the period over which the RI was performed, there were no indications of fish in this pond nor were any fishing activities observed. The wetlands are hydrologically isolated from Oyster Creek (and the Intracoastal Waterway), except during intermittent, and typically brief, flooding events. This lack of hydraulic connection prevents the wetlands from being a hatchery or nursery for fish that, as they mature, could move to larger water bodies. In addition, it is unlikely that fish of consumable size live in the wetlands given the shallow depth of standing water.

2.2.2 Comparison to the Background Areas

The background evaluation was conducted using the approach outlined on page 5-19 of EPA guidance (EPA, 1989), which indicates "If inorganic chemicals are present at the site at naturally occurring levels, they may be eliminated from the quantitative risk assessment". COIs were retained for further evaluation in the BHHRA if they were measured in Site media at a concentrations that was statistically different (higher) than background soils.

To help provide an understanding of what COIs and concentrations are considered to be Site-related, a background evaluation was conducted (as described in the Work Plan (PBW, 2006a)) that included: 1) soil samples from ten off-site locations; 2) sediment samples from nine off-site locations in the Intracoastal Waterway; and 3) surface water samples within four off-site "zones" in the Intracoastal Waterway. This information was used to characterize Site conditions in the NEDR (PBW, 2009).

The soil background data were compared to soil from the South Area and North Areas of the Site, as well as sediments from the North wetland and the North Area ponds. As described in the NEDR (PBW, 2009), based on similarities in composition and condition between background soil and sediments of the North wetlands area, this comparison was appropriate. Sediment and surface water data for the Intracoastal Waterway samples were compared to sediment and surface water data collected in the Intracoastal Waterway background location.

Comparisons between Site sampling data and Site-specific background data were conducted for all inorganic compounds measured regardless if they exceeded the concentration-toxicity screen. The background comparisons were performed in accordance with EPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA, 2002d). Distribution testing was conducted to estimate 95% UCLs and the summary statistics were used to perform comparison of the means analyses. The output of these background statistical comparison tests is provided in Appendix B. Table 18 summarizes the results of the testing and indicates whether the Site data were found to be statistically different than the background data.

In several instances (e.g., lithium in South Area soil; barium in North Area wetlands sediment), statistical differences between the two data sets were due to higher concentrations in the background population, as noted in Table 18. If there was not Site-specific background data for a COI (as noted in Table 18 with an "NA") and it was measured in excess of $1/10^{th}$ of the screening level, the COI was retained for further

evaluation in the BHHRA (e.g., iron). COIs shown to be statistically different (and higher) when compared to background data were also retained for quantitative evaluation in the BHHRA.

A statistical comparison between Site surface water and background surface water could not be conducted given the small size of both data sets. Visual inspection of the data indicates that there is no consistent observable difference between the data sets for the COIs. It should be noted, however, that all COIs in surface water were screened out during the toxicity-concentration step and are not evaluated further in the BHHRA.

Background groundwater data were not collected as part of the RI. Therefore, all COIs detected in Zone A groundwater, as shown in Tables 3 and 10 for the South Area and North Area, respectively, were evaluated quantitatively in the BHHRA and are discussed in greater detail in the following sections.

2.2.3 Summary of Potential Chemicals of Concern

The PCOCs carried through the BHHRA for soil, surface water, and sediment are listed in Table 19. For a COI to be considered at PCOC, it was:

- Measured in more than percent of the samples for a given media;
- Measured at a concentration greater than $1/10^{th}$ of the screening criteria or measured but no screening criteria are available; and
- Measured at a concentration statistically greater than what is considered background.

PCOCs were quantitatively evaluated further in the BHHRA. Based on the comparison with screening criteria, COIs measured in surface water and, thereby, the surface water pathway were eliminated from further evaluation in the BHHRA because none were measured above their respective screening value. Likewise, the pathway for off-site residential exposure to fugitive dust and VOC emissions from soils at the South Area and North Area was eliminated from further evaluation because no COIs were measured above their screening criteria for this pathway. These media, South Area and North Area soil, were retained for further evaluation for other receptors and pathways. Table 20 summarizes the media of interest, potential exposure pathways by media, and the general outcome of the screening process for that media.

3.0 EXPOSURE ASSESSMENT

The exposure assessment estimates the extent of human contact with PCOCs by characterizing potentially exposed populations (i.e., receptors), identifying actual or potential routes of exposure, and quantifying the intake (or dose) of human exposure. The exposure assessment also identifies possible exposure pathways that are appropriate for each potential receptor and exposure scenario and considers the source of contamination and fate and transport properties of the compound and surrounding environment. An exposure pathway typically includes the following elements:

- A source of contaminant and mechanism of contaminant release;
- An environmental retention or transport medium (e.g., air, groundwater, etc.);
- A point of contact with the medium (i.e., receptor or potentially exposed population); and
- A route of human intake (e.g., inhalation, ingestion, etc.).

Each of these elements must generally be present for an exposure pathway to be complete, although it is not necessary that environmental transport occurs when assessing exposure from direct contact. Exposure was evaluated for both current and potential future receptors to allow for evaluation of long-term risk management options.

3.1 POTENTIAL EXPOSURE PATHWAY EVALUATION

The identification of potentially exposed populations (also called receptors) possibly at risk from exposure to PCOCs at the Site is dependent on current and future land uses. The Site is located at 906 Marlin Avenue in Freeport, TX, as shown on Figure 1.

The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west (Figure 1). Approximately 78 people live within the one square mile area surrounding the Site (EPA, 2005a). Approximately 3,392 people live within 50 square miles of the Site (EPA, 2005a). There are no schools, nursing homes, or other sensitive subpopulations within a mile of the Site. Residential areas are located south of Marlin Avenue, approximately 300 feet west of the Site, and 1,000 feet east of the Site.

3.1.1 Land Use Evaluation

Historically, the South Area of the Site was used as a barge cleaning and maintenance facility. The Site currently is unused but it is anticipated that the South Area will be used for commercial/industrial purposes in the future. The South Area includes approximately 20 acres of upland that was created from dredged material from the Intracoastal Waterway. To the west of and directly adjacent to the Site is an unused lot that was formerly a commercial marina. West of that lot, beyond a second vacant lot, is a residential development with access to the Intracoastal Waterway. An active commercial operation is located east of the South Area.

The North Area of the Site contains closed surface impoundments (closed in 1982) and is, for the most part, unused. Some of the North Area is upland created from dredge spoil, but most of this area is considered wetlands (Figure 2) and the wetlands area has never consistently been used. According to the National Wetlands Inventory map for the Freeport Quadrangle, the wetlands on the north of the Site are estuarine, intertidal, emergent, persistent, and irregularly flooded. The upland area of the North Area has been used as a parking lot. Future land use at the North Area is limited given that much of it is considered wetlands and most of the upland part of the North Area consists of the closed former surface impoundments.

3.1.2 Groundwater Use Evaluation

Because of high total dissolved solids in Zone A, B, and C groundwater at the Site, the groundwater ingestion and use pathway is incomplete for these three units. Also, as noted previously, restrictive covenants prohibiting groundwater use have been filed for the Site. Based on Site potentiometric and analytical data presented in the NEDR (PBW, 2009), impacted groundwater does not affect surface water at the Site. Additional information regarding the geologic and hydrogeologic characteristics of these units will be provided in the RI Report.

3.1.3 Surface Water Use Evaluation

The Intracoastal Waterway supports barge traffic and other activities. It is one of the main arteries for shipping goods from Freeport's deep-water port to destinations along the Texas Coast and beyond. Fishing boats also use the Intracoastal Waterway to gain access to the fishing grounds in the Gulf of

Mexico and the shorelines, tributaries, and marshes of the many Texas Bays. The area near the Site is regularly dredged. The nearby residential areas have canal access to the Intracoastal Waterway.

As noted previously, impacted groundwater does not discharge to surface water at the Site. However, surface water data were collected for the Intracoastal Waterway, as well as surface waters contained in the wetlands and ponds on the North Area to evaluate the potential for contaminants in surface soils to be released to surface water via overland surface runoff.

3.1.4 Fish and Shellfish Resources Evaluation

As mentioned previously, fishing and crabbing are reported to occur in waters of the Intracoastal Waterway in the general vicinity of the Site. Fishing and crabbing have not been observed in the wetlands or ponds of the North Area primarily because neither provide suitable habitat for consumable fish or blue crabs (e.g., larger fish and mature blue crabs prefer deeper water habitat).

Subsistence fishing was not considered in the Intracoastal Waterway Fish Ingestion Pathway Human Health Baseline Risk Assessment (PBW, 2007) because of the small shoreline of the Site and other considerations described below. Subsistence fishing is generally characterized by individuals who catch fish as their primary protein source and, although a formal study has not been conducted, there are no known subsistence populations in the Freeport area. The habitat along the Intracoastal Waterway is generally not conducive to attracting and keeping fish and their prey due to the poor sediment base that results from scouring, dredging and wave action from barge traffic. Moreover, given the significant barge and boat traffic in the area, it is unlikely that a fisherman would routinely fish near the Site due to safety concerns. It was, therefore, assumed that a recreational fishing scenario best represented possible and likely fishing patterns in the Intracoastal Waterway near the Site.

Molluskan shellfish harvesting is currently banned by the TDSHS in all waterbodies from an area about two miles east of the Site, to well beyond the Brazos River inlet, about 7 miles west of the Site (TDSHS, 2009). The ban has been enacted because of poor conditions and water quality. It should be noted, however, that risk from molluskan shellfish consumption harvested from the area if allowed would most likely not pose a human health risk, since exposure would be similar if not the same as for the fish and crab (a crustacean shellfish) ingestion pathway, which as described in Section 5.4 below was found to pose an acceptable risk in the Site vicinity.

3.2 POTENTIALLY EXPOSED POPULATIONS

Potentially exposed populations were based on current and reasonable future land use, groundwater use, and surface water use. Table 20 describes the potentially exposed populations that may encounter COPCs at the Site. Table 21 summarizes the various exposure scenarios evaluated in the BHHRA by media. While exposure might occur at the background locations, exposure and potential risks for the background areas were not evaluated in the BHHRA.

Potentially exposed populations for the South Area and North Area include:

1. future commercial/industrial workers;
2. future construction workers at the Site;
3. current/future youth trespasser (although the South Area perimeter is fenced, this area could still be accessed by a trespasser via the Intracoastal Waterway);
4. contact recreation receptor ; and
5. off-site residential receptor.

Soil is the primary media of concern for the commercial/industrial worker, construction worker, and youth trespasser receptor while surface water and sediment are the primary media of concern for the contact recreation receptor. A future indoor air exposure pathway was evaluated for the commercial/industrial worker since VOCs were detected in Zone A groundwater. Additionally, a contact recreation scenario was assessed for surface water and sediment in the Intracoastal Waterway, wetlands, and ponds to represent a hypothetical person that occasionally contacts these media while swimming, wading, or participating in other recreational activities. Potential impacts from fugitive dust generation and VOC emissions, and subsequent exposure to nearby residents were also considered in the BHHRA. It should be noted that the off-site residential receptor and surface water exposure to the contact recreation receptor were eliminated from further quantitative evaluation in the BHHRA, as described in Section 2.2.

A recreational fishing receptor was identified as the potential receptor of concern in the Fish Ingestion Pathway Human Health Baseline Risk Assessment (PBW, 2007), and a quantitative evaluation of risks for this potentially exposed population was presented in the report. The conclusions of that report are summarized in Section 5.4.

3.3 CONCEPTUAL SITE MODELS AND POTENTIALLY COMPLETE EXPOSURE PATHWAYS

A conceptual site model (CSM) identifies exposure pathways for potentially complete pathways at the Site and describes the process or mechanism by which human receptors may reasonably come into contact with Site-related constituents. A CSM was developed as part of the Work Plan (PBW, 2006a) to focus the data collection activities of the RI so that analytical data could support a risk-based analysis. These preliminary CSMs were included as Figures 7 and 8 in the Work Plan (PBW, 2006a) and summarized exposure to the North Area and South Area, respectively.

Figures 4 and 5 of the BHHRA provide revised CSMs for the South and North Areas, respectively, which were refined to reflect current information about the Site. These revised CSMs were used to develop the quantitative exposure assessment of the BHHRA. Complete pathways are indicated with a bold line and check in the potential receptors column. Incomplete pathways are denoted with an "X" and a footnote indicating why the pathway is incomplete.

At the South Area, PCOCs were potentially released from historical Potential Source Areas (PSAs) to the soil and may have migrated to groundwater via leaching through the soil column, and to surface water in the Intracoastal Waterway via overland surface runoff. Once in surface water, some compounds tend to stay dissolved in the water whereas some tend to partition to sediment. Volatilization and fugitive dust generation may have caused PCOCs in soil to migrate within the Site or off-site. Exposure to on-site receptors may also occur directly from contact to the soil. However, based on PCOC data for surface soil samples collected on Lots 19 and 20 directly west of the Site (see Section 2.4.2 of the NEDR for detailed discussion of these data (PBW, 2009)) and the qualitative screening conducted for the off-site residential receptor described in Section 2.2, it does not appear that significant entrainment and subsequent deposition of particulates occurred at the Site or at off-site locations. Once in groundwater, VOCs may migrate with the groundwater and/or volatilize through the soil pore space and be emitted into outdoor or indoor air.

At the North Area, PCOCs were potentially released from historical PSAs to the soil and/or may have migrated to groundwater. PCOCs may have also migrated from soil to surface water and sediments in the nearby wetlands area via overland surface runoff. Fugitive dust generation was considered a potentially significant transport pathway for PCOC migration on-site and evaluated quantitatively in the BHHRA for the on-site receptors although this pathway was eliminated during the screening process for the off-site

residential receptor. Once in groundwater, VOCs may migrate with the groundwater and/or volatilize through the soil pore space and be emitted into outdoor or indoor air.

It was assumed, as part of the risk assessment, that these media were potentially contacted by the various hypothetical receptors possibly at the Site and, as such, these exposure pathways were potentially complete. The remainder of this section describes how exposure was quantified for each of these complete exposure pathways.

3.4 QUANTIFICATION OF EXPOSURE

In keeping with EPA guidance (EPA, 1992c), the goal of the exposure assessment was to provide a reasonable, high-end (i.e., conservative) estimate of exposure that focuses on potential exposures in the actual population. This concept is termed the reasonable maximum exposure (RME) approach. This should not be confused with: (1) a worst-case scenario which refers to a combination of events and conditions such that, taken together, produces the highest conceivable exposure; or (2) a bounding estimate that purposefully overestimates exposure (EPA, 1992c). Thus, in accordance with EPA guidance, site-specific exposure assumptions and parameters were used when available and, when not available, assumptions were deliberately chosen to represent a high-end RME estimate (EPA, 1989). A central tendency or average scenario was also evaluated to provide a range of exposures.

Chemical exposure is quantified by the calculation of an intake, or dose, that is normalized to body weight and exposure time of the receptor. A dose is calculated by combining assumptions regarding contact rate (intake amount and time, frequency and duration of exposure) to a contaminated medium with representative chemical exposure point concentrations for the medium of concern at the point of contact. Receptors are chosen based on their exposure patterns that may put them at risk or at a higher risk than other individuals. Intake assumptions, in general, were based on central tendency or RME assumptions determined by EPA (1989; 1991a), or were based on information obtained from site-specific studies. Reasonable maximum exposure scenarios use a combination of assumptions, such as average values for physical characteristics of the receptors (body weight and corresponding body surface area), UCL values (values at the 90 or 95 percentile of the distribution) for contact rate, and UCL on the mean (95 percent UCL) for the exposure point concentrations. The combination of these factors is assumed to provide an upper-bound estimate of exposure and risk to that particular receptor.

The intake or dose of a particular compound by a receptor is quantified with the generic equation below (EPA, 1989):

$$I = \frac{C \times CR \times EFD}{BW} \times \frac{1}{AT} \qquad \text{(Equation 1)}$$

where:

I	=	the compound intake or dose (mg/Kg BW-day);
C	=	the compound concentration (mg/Kg or mg/L);
CR	=	contact rate or the amount of contaminated medium contacted per event (L/day or mg/day);
EFD	=	the frequency (days/year) and duration (number of years) of exposure days;
BW	=	the average body weight of the receptor (Kg); and
AT	=	averaging time of the exposure (days); for noncarcinogens, AT equals (ED) x (365 day/year); for carcinogens, AT equals (70 years over a lifetime) x (365 day/year).

This equation calculates an intake that is normalized over the body weight of the individual and the time of the exposure. Because the intake or dose is combined with quantitative indices of toxicity (chemical-specific dose-response information such as reference doses (RfDs) for noncarcinogenic compounds or cancer slope factors (CSFs) for carcinogenic compounds, which is discussed further in Section 4.0) to give a measure of potential risk, the intake or dose must be calculated in a manner that is compatible with the quantitative dose-response information for chemical constituents evaluated in the analysis. Two different types of health effects are considered in this analysis: 1) carcinogenic effects and 2) noncarcinogenic effects (either chronic or subchronic, depending on the receptor's exposure).

For carcinogenic effects, the relevant intake is the total cumulative intake averaged over a lifetime because the quantitative dose-response function for carcinogens is based on the assumption that cancer results from chronic, lifetime exposures to carcinogenic agents. This intake or dose is then averaged over a lifetime to provide an estimate of intake or dose to carcinogens as (mg/Kg-day), which is expressed as a lifetime average daily dose (LADD). Thus, for potentially carcinogenic compounds, the averaging time (AT) is equal to 70 years (EPA, 1989).

Noncarcinogenic effects are evaluated for chronic, subchronic, or acute exposures by receptors to systemic or reproductive toxicants. For noncarcinogenic effects, the relevant intake or dose is based on the daily intake averaged over the exposure period of concern. As defined in EPA guidance (EPA, 1989), an exposure period for toxicity can be either acute (exposure occurring from one event or over one day), subchronic (cumulative exposures occurring from two weeks up to seven years), or chronic (cumulative exposure over seven years to a lifetime in duration). The quantitative dose-response function for

noncarcinogenic effects (chronic and subchronic) is based on the assumption that effects occur once a threshold dose is attained from repeated exposure. Therefore, the intake or dose for noncarcinogenic risk assessment is based on an average daily dose (ADD) that is averaged over the duration of exposure. The averaging time for assessing noncarcinogenic effects is equal to the exposure duration for the receptor. In the BHHRA, exposure was assumed to be chronic for all receptors even though some exposures described in this report were intermittent or less than chronic duration.

3.4.1 Estimating the Exposure Point Concentration

The exposure point concentration (EPC) is meant to be "a conservative estimate of the average chemical concentration in an environmental medium" (EPA, 2002b). The EPA (2002b) also states that the 95% UCL should be used as the EPC for a given area and its sample concentrations. The EPA's ProUCL Version 4.00.04 software program (EPA, 2009) was used to calculate distribution-free (i.e., nonparametric) 95% UCL concentrations from data sets including non-detect concentration values (i.e., represented by the sample quantitation limit). ProUCL calculates various types of the 95% UCL, and then makes a recommendation for the most appropriate UCL type. In instances where the generated output did not indicate a recommended UCL type, then rules based on the EPA guidance (EPA, 2009) were used to choose the most appropriate UCL. If the sample size was small or there was a large proportion of non-detect concentrations in a particular data set, EPA guidance (EPA, 2009) noted that a computed 95% UCL would not be reliable or justifiable. Instead, the guidance recommended using the median or mode value of the entire data set (i.e., detected and non-detected concentrations) to represent the EPC.

The following rules were used to select the most appropriate UCL based on EPA guidance (EPA, 2009), based on the nature of the data set:

1. Select the recommended UCL, unless the number of detections was less than 8.
2. If the number of detections was less than 8, compute median value of entire data set and select it for the EPC.
3. If number of detections is 8 or more, **and** no UCL is recommended **and** non-detects are less than five percent **and** data distribution appears normal (often the case for metals) **and** there are not multiple sample quantitation limits, then select the Winsor (t) UCL or the Student's (t) UCL.
4. If number of detections is 8 or more **and** no UCL is recommended **and** non-detects are greater than five percent, then select the highest Kaplan-Meier (KM) UCL other than the 99% KM

(Chebyshev) UCL (considered to be too conservative) if it is less than the maximum detected value.

5. If the number of detections is 8 or more **and** no UCL is recommended **and** non-detects are less than five percent **and** data distribution is not normal, then select the highest KM UCL other than the 99% KM(Chebyshev) (conserved too conservative) UCL if it is less than the maximum detected value.

Appendix A provides the ProUCL output when there were sufficient samples to generate statistics (soil and sediment). It should be noted that when evaluating exposure from fugitive dust generation, the EPC was based on surface soil data because it is unlikely that deeper soils (i.e., soils below a depth of 0.5 ft) are transported as wind-borne dust.

Both averages and 95% UCLs (or means or medians where appropriate as discussed above) were used in the BHHRA to provide a range of EPCs and are summarized in Tables 1 through 15. The dose estimates using the 95% UCL EPC were considered to represent reasonable maximum exposure (RME). The average was used to represent the average or central tendency exposure. It should be noted that with more robust data sets, the average and 95% UCL EPCs are very similar. It should also be noted that often, for data sets with a high percentage of non-detects, the average of detected data are higher than the recommended UCL (or RME) value since, with these types of datasets, the median value is often the recommended UCL and is often lower than the average of the detected data.

3.4.2 Quantifying Intake

To quantify potential exposures associated with the pathways of potential concern, Equation 1 is modified according to the specific exposure routes and intake assumptions.

Incidental Ingestion of Soil. The intake or dose for the incidental ingestion pathway from soil is calculated based on the following equation (EPA, 1989):

$$ADD_{ing} = \frac{Conc_{soil} \times IR \times FI \times AAF \times EF \times ED \times CF}{BW \times AT} \quad \text{(Equation 2)}$$

where:

ADD_{ing}	=	average daily intake of compound via ingestion of soil (mg/Kg BW-day);
$Conc_{soil}$	=	exposure concentration in soil (mg/Kg);
IR	=	ingestion rate (mg soil/day);
FI	=	fraction ingested (unitless);
AAF	=	absorption adjustment factor (fraction absorbed);
EF	=	exposure frequency (days/year);
ED	=	exposure duration (years);
CF	=	conversion factor (10^{-6} Kg/mg);
BW	=	body weight (Kg); and
AT	=	averaging time (days).

The exposure concentration in the soil ($Conc_{soil}$) is the concentration of a PCOC at the point of contact. Exposure point concentrations represent random exposure over the exposure unit and were discussed in greater detail in the Section 3.4.1. The ingestion rate (IR) is the amount of soil incidentally ingested per day or event. For soil, the incidental intake values vary according to the receptor and the specific activities or exposure patterns that the receptor is engaged in at the Site.

The fraction ingested (FI) relates to the fraction of soil that is contacted daily from the contaminated area. This is highly dependent on the different activities that an individual is engaged in and the number of hours (fraction of time) spent in the contaminated portions of the site (EPA, 1989). The fraction ingested was conservatively assumed to be 100 percent. The absorption adjustment factor (AAF) is used in the ingestion pathway to account for differences in relative absorption for the chemical from the test vehicle versus the exposure medium (i.e., soil) and was assumed to be 1.0 unless compound-specific data were available to suggest otherwise. (The test vehicle is the material (e.g., soil, food, or solvent) in which the chemical was administered in the toxicity study.) Body weight (BW) varies according to the age range of the receptor. Adult receptors are assumed to weigh 70 kilograms (Kg), which corresponds to the 50^{th} percentile value for all adults, as recommended by EPA (1989). For receptors other than adults, body weight is dependent on the age of the receptor and is calculated as the time-weighted average body weight using values reported by the *Exposure Factors Handbook* (EPA, 1997a). The exposure frequency (EF) and duration (ED) of the event is based on the particular exposure pattern and activity related to the receptor (EPA, 1997a). The averaging time is 70 years for carcinogenic effects, and for noncarcinogenic effects depends on the frequency and duration of exposure for the particular receptor (EPA, 1989; 1991a).

Dermal Contact with Soil. When calculating intake via dermal contact with soil or sediment, Equation 1 is modified slightly to account for skin surface area, soil-to-skin adherence factors, and chemical-specific absorption factors. An intake or dose is quantified from dermal contact with the equation (EPA, 1989):

$$ADD_{der} = \frac{Conc_{soil} \times SA \times AF \times AAF \times EF \times ED \times CF}{BW \times AT} \qquad \text{(Equation 3)}$$

where:

ADD_{der}	=	average daily dose from dermal contact with chemical in soil (mg/Kg-day);
$Conc_{soil}$	=	exposure concentration in soil (mg/Kg);
SA	=	skin surface area available for direct dermal contact (cm^2/event);
AF	=	soil/sediment to skin adherence factor (mg/cm^2);
AAF	=	absorption adjustment factor (unitless)
EF	=	exposure frequency (days or events/year);
ED	=	exposure duration (years)
CF	=	conversion factor (10^{-6} Kg/mg);
BW	=	body weight (Kg); and
AT	=	averaging time (days).

The exposed skin surface area (SA) is the area or portion of the body exposed for dermal contact. As with many exposure variables, surface area depends on the age and exposure pattern that the receptor is engaged in that relate to repeated or average exposure. Surface area can be predicted based on factors such as activity and types of clothing. Typical exposures via dermal contact for most receptors are generally limited to certain parts of the body (e.g., hands, forearms, head, and neck) since clothing tends to significantly reduce the potential for direct contact with soil (Kissel, 1995). The soil adherence factor (AF) is the density of soil adhering to the exposed fraction of the body. The adherence factor is highly dependent on the specific activity of the receptor as well as physical properties of the soil (e.g., moisture content, textural class, and organic carbon content) (Kissel et al., 1996). The AAF accounts for the relative absorbance of a chemical between dermal exposure from the environmental medium and oral exposure in the critical toxicity study, which was used to derive the dose-response information for that chemical. Therefore, the AAF is highly chemical-specific and, unless otherwise noted, was assumed to be 1.0. Factors such as body weight, exposure frequency, exposure duration, and averaging time are similar to that discussed above for incidental ingestion.

Inhalation of Volatiles and Fugitive Dusts. An intake or dose from inhalation of vapors or particles emitted from the Site is calculated by modifying Equation 1 to account for the volatilization and/or particulate emission factor and the difference in methodology when evaluating air impacts (i.e., dose was not calculated, but rather an effective air concentration that the receptor may be exposed to was calculated). An effective air concentration was generally calculated using the following equation:

$$EAC = Conc_{soil} \times VF \times EF \times ED/AT \qquad \text{(Equation 4)}$$

where:

EAC	=	effective air concentration (mg/m^3);
$Conc_{soil}$	=	exposure point concentration in soil (mg/Kg);
VF	=	volatilization factor (mg/m^3-air/Kg-soil) and/or particulate emission factor:
EF	=	exposure frequency; describes how often exposure occurs (days/year);
ED	=	exposure duration; describes how long exposure occurs (years); and
AT	=	averaging time; period over which exposure is averaged (days).

A risk assessment from inhalation of volatiles and dusts is different from the quantification of potential risks from dermal contact or incidental ingestion. Risks from inhalation exposure are based on a comparison of a measured or calculated air concentration (effective air concentration) to a risk-based acceptable air concentration, either a reference concentration (RfC) or an inhalation unit risk (IUR) value. Where monitoring data do not exist, an exposure point concentration in air can be calculated based on a volatilization model and/or particulate emissions factor and the exposure point concentration in soil. Surface soil data were used when estimating the air concentration for particulate dust generation.

3.4.3 Exposure Assumptions and Intake Calculations

The exposure assumptions are provided in Tables 22, 23, 24, and 25 for the industrial worker, construction worker, youth trespasser, and contact recreation receptors, respectively. References for the various assumptions are provided in the tables and citations are listed in Section 8.0. Appendix C provides the detailed spreadsheets for the intake calculations for the different receptors for the South and North Areas of the Site.

3.4.4 Vapor Intrusion Pathway for Future On-Site Worker Scenarios

Except for an AST farm, a dry dock, and a former transformer shed, there are currently no structures present on the South or North Areas at the Site. However, future development of the area may result in construction of buildings at the Site. In the event that permanent and enclosed structures are built on-Site in the future, the Johnson and Ettinger Vapor Intrusion Model (J&E VIM) (EPA, 2002a) was used to assess the potential migration of volatile chemicals from groundwater into the breathing space of an overlying building. Exposure estimates are calculated in the model using default exposure parameters for

an industrial worker similar to those provided in Table 22 and site-specific soil and hydrogeologic properties. While a construction worker could also be exposed to VOCs migrating from groundwater to outdoor air, that exposure and risk scenario was not calculated separately since it is likely to be less than the industrial worker's exposure under the indoor air scenario since there would be greater dispersion and mixing in the ambient outdoor air that a construction worker would encounter (no dispersion and mixing is assumed with the J&E VIM), and because the construction worker's exposure frequency and duration is less than the industrial worker's.

The input parameters used to run the J&E VIM Version 3.1 followed EPA guidance on the subject and recommended values (EPA, 2002a) that are available on-line at www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm . Site-specific input variables used in the model are described below. The model was only run for those compounds that are considered volatile since non-volatile compounds would not migrate from the groundwater to the overlying soil pore space and to ambient air via this pathway. As noted previously, a restrictive covenant is currently in place for Lots 55, 56, and 57 and requires any building design to preclude vapor intrusion. Thus, this evaluation represents a conservative assessment of the vapor intrusion pathway for these lots.

The site-specific variables used in the J&E model were determined from information gathered during previous Site investigation and presented in the NEDR (PBW, 2009). Depth below grade to the bottom of a hypothetical enclosed space floor was assumed to be 15 cm, or the thickness of a typical slab (basement construction was not considered due to the geographic location of the Site). Depth below grade to the water table was conservatively estimated to be 5 feet (152 cm) based on water gauging data from both North and South Area monitoring wells. Clay (USCS code CL) was selected as the soil type directly above the water table, which is the dominant soil type in shallow soils at both the North and South Areas as indicated on the boring logs provided in NEDR (PBW, 2009). The average soil/groundwater temperature used in the model was 25° C based on the geographical location of the site and regional climatic conditions.

Both average and RME EPCs were used in the calculations to provide a range of exposure and potential risks. These values are listed in Tables 26 and 27, respectively for the South Area and North Area groundwater. Estimated risks are provided and discussed in Section 5.0.

4.0 TOXICITY ASSESSMENT

The toxicity assessment provides a description of the relationship between a dose of a chemical and the anticipated incidence of an adverse health effect (Preuss and Ehrlich, 1987 and EPA, 1989). The purpose of the toxicity assessment is to provide a quantitative estimate of the inherent toxicity of PCOCs to incorporate into the risk characterization. Toxicity values are derived from the quantitative dose response association and are correlated with the quantitative exposure assessment in the risk characterization.

For risk assessment purposes, toxic constituent effects are separated into two categories of toxicity: carcinogenic effects and noncarcinogenic effects. This division relates to the EPA policy that the mechanisms of action for these endpoints differ. Generally, the EPA has required that potentially carcinogenic chemicals be treated as if minimum threshold doses do not exist (EPA, 1986), whereas noncarcinogenic effects are recognized to have a threshold below which toxicity is unlikely.

4.1 EXPOSURE ROUTE-SPECIFIC TOXICITY CRITERIA

In deriving toxicity criteria, EPA methodologies consider the route of administration (or exposure) of the test chemical in toxicity or epidemiological studies. Typically oral reference doses (RfDs) and oral cancer slope factors (CSFs) are derived from toxicity studies with oral administration or exposure route, and reference concentrations (RfCs) or inhalation unit risks are derived from inhalation toxicity studies. While one could attempt to extrapolate an inhalation toxicity criterion to the oral pathway or visa versa, this practice is not recommended because there can be a great deal of uncertainty introduced (EPA, 1989). Therefore, in the BHHRA, oral RfDs were not extrapolated to provide toxicity values for inhalation pathways. Quantitative risk evaluation of the inhalation exposure pathways was conducted only for those chemicals that have reference toxicity values specifically from inhalation administration.

On the other hand, EPA has not derived specific toxicity criteria for the dermal exposure pathway. This presents a complication because oral and inhalation toxicity criteria are based on administered dose and not absorbed dose while dermal exposure pathways consider the absorbed dose (i.e., how much of the chemical in soil or water crosses the skin barrier and is absorbed by the body). Per EPA (1989), the oral RfD or oral CSF can be applied in evaluation of the dermal exposure pathway following adjustment of the oral toxicity criteria for gastrointestinal absorbance. In later guidance (EPA, 2004b), EPA recommends adjusting oral toxicity criteria by gastrointestinal absorbance factors if gastrointestinal absorbance of the chemical in the vehicle of administration in the critical study is less than 50 percent. Generally, organic

chemicals are assumed to be relatively bioavailable in oral and gavage toxicity studies and, thus, the administered dose is likely to be similar to absorbed dose. Therefore, no adjustment of oral toxicity criteria is recommended for organic PCOCs (EPA, 2004b). EPA recommends adjusting oral toxicity criteria for a number of inorganic constituents based on the possibility of low gastrointestinal absorbance in the critical study as shown in Exhibit 4-1 of the associated guidance (EPA, 2004b). It should be noted that none of the PCOCs quantitatively evaluated in the BHHRA are recommended for the adjustment described above.

4.2 CARCINOGENIC EFFECTS

Potential carcinogenic effects resulting from human exposure to constituents are estimated quantitatively using CSFs, which represent the theoretical increased risk per milligram of constituent intake/kilogram body weight/day $(mg/Kg\text{-}day)^{-1}$ or unit risks, which are the theoretical increased risks per exposure concentration. CSFs or unit risks are typically derived for "known or probable" human carcinogens. CSFs or unit risks are used to estimate a theoretical upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular lifetime daily dose of a potential carcinogen. Constituents that are believed to be carcinogenic may also have non-cancer effects. Potential health risks for these constituents are evaluated for both cancer and other types of effects as described below.

4.3 NONCARCINOGENIC EFFECTS

Unlike carcinogenic effects, it is widely accepted that noncarcinogenic biological effects of chemical substances occur only after a threshold dose is achieved (Klaassen et al., 2007). This threshold concept of noncarcinogenic effects assumes that a range of exposures up to some defined threshold can be tolerated without appreciable risk of harm. Adverse effects may be minimized at concentrations below the threshold by pharmacokinetic processes, such as decreased absorption, distribution to non-target organs, metabolism to less toxic chemical forms, and excretion (Klaassen et al., 2007).

RfD values and RfCs are developed by the EPA RfD Work Group on the basis of a wide array of noncarcinogenic health effects. The RfD and RfC are estimates of the daily maximum level of exposure to human populations (including sensitive subpopulations) that are likely to be without an appreciable risk of deleterious effects during a lifetime (EPA, 1989). RfDs are expressed in units of daily dose (mg/Kg-

day) while RfCs are expressed as an air concentration (mg/m^3). Both incorporate uncertainty factors to account for limitation in the quality or quantity of available data.

4.4 SOURCES OF TOXICITY CRITERIA

There are a variety of toxicity databases that regulatory agencies rely on for the purposes of quantifying the toxicity of chemicals in the environment. Per EPA (1989 and 2003), the primary source (i.e., "Tier 1") for toxicity information in the risk assessment should be EPA's IRIS (EPA, 2008). According to a recent EPA Office of Solid Waste and Emergency Response (OSWER) Directive (EPA, 2003), that revises the human health toxicity value hierarchy, if RfDs for noncarcinogenic compounds and CSFs for possible carcinogens are not available in IRIS, the "Tier 2" toxicity resource is the EPA's database of Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV). The "Tier 3" resources that can be consulted if IRIS and PPRTV databases lack relevant toxicity criteria include the Health Effects Assessment Summary Tables (EPA, 1997b) and the Centers for Disease Control's Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs). Toxicity values contained in the Region 6 Human Health Medium-Specific Screening Levels (EPA, 2004a) were also used as a resource for toxicity values.

The toxicity criteria used in the BHHRA are provided in Appendix D, along with the risk calculations. All toxicity values were obtained from EPA's IRIS on-line database, as accessed during December 2008.

5.0 RISK CHARACTERIZATION

Risk characterization is the integration of the exposure and toxicity information to make quantitative estimates and/or qualitative statements regarding potential risk to human health. This section describes the risk characterization process for carcinogenic and noncarcinogenic PCOCs.

5.1 POTENTIAL CARCINOGENIC RISKS

Potential carcinogenic effects are characterized in terms of the excess probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. For chemicals that exhibit carcinogenic effects, EPA has developed a model that is based on the theory that one or more molecular events as a result of exposure to a potential carcinogenic compound can evoke changes in a single cell or a small number of cells that can lead to tumor formation. This non-threshold theory of carcinogenesis suggests that any level of exposure to a carcinogen can result in some finite possibility of generating the disease. It should be noted that this is a very conservative approach and EPA's more recent Guidelines for Cancer Risk Assessment (EPA, 2005b) recognize that there are "threshold" carcinogens as well.

To characterize the potential for carcinogenic effects, a lifetime average daily dose (LADD) is combined with a CSF to calculate a probability that an individual would develop cancer over a lifetime of exposure to a specific PCOC, with the following equation:

$$\text{Risk} = \text{LADD} \times \text{CSF} \qquad \text{(Equation 5)}$$

All risk estimates are summed for the receptor by media to provide a theoretical excess lifetime cancer risk. Theoretical excess lifetime cancer risks are evaluated based on an acceptable cancer risk range of 1×10^{-6} to 1×10^{-4}. EPA (1991b) indicates that carcinogenic effects at a site should first be evaluated based on the 1×10^{-4} cancer risk levels, but depending on site-specific conditions, a range of 1×10^{-6} to 1×10^{-4} may be used. Typically, cancer risks less than 1×10^{-6} are considered *de minimis* and acceptable while cancer risks less than 1×10^{-4} are considered acceptable (EPA, 1991b).

The BHHRA evaluated site-specific exposures based on realistic current and possible future land use. All cancer risk estimates fell within the EPA cancer risk range of 10^{-6} to 1×10^{-4} or less, except for the hypothetical industrial worker scenario at the North Area. Exposure from the vapor intrusion pathway for

PCOCs in groundwater for a hypothetical industrial worker employed in a building sited at the North Area resulted in a cancer risk greater than 1×10^{-4}, as shown in Table 27. Table 28 provides a summary of the cancer risk estimates for each scenario using average and RME assumptions for the soil and sediment pathways. Detailed spreadsheets containing the risk calculations are provided in Appendix D by scenario and media.

Risks were summed for the hypothetical industrial worker scenario that might be exposed to both soil and vapors emanating from groundwater, as shown in Table 28. The total risk for the hypothetical RME industrial worker at the South Area was 7×10^{-6} while the total risk for the hypothetical RME industrial worker at the North Area was 1.6×10^{-1}. The "unacceptable" risk driver for the hypothetical industrial worker scenario at the North Area was the inhalation of vapors emanating from groundwater. Risks were not summed for other soil and sediment-based receptors since adding across areas or media would, in fact, "double count" the exposure assumptions nor is it likely or determinable that a receptor will be exposed to multiple media. It would be reasonable to add surface water and sediment exposure for the contact recreation pathway but the surface water pathway was shown to be a *de minimus* risk and screened out as discussed in Section 2.2.

5.2 POTENTIAL NONCARCINOGENIC HAZARD QUOTIENTS

For noncarcinogenic compounds, a potential hazard is expressed as a hazard quotient (HQ), which is the ratio of the average daily dose (ADD) for a site-specific receptor to an acceptable dose (or RfD) for that compound. The HQ is calculated as follows

$$HQ = ADD/RfD \qquad \text{(Equation 6)}$$

An RfD is developed with the assumption that the degree of toxicity of noncarcinogenic compounds is based on the ability of organisms to repair and detoxify after exposure to a compound. The repair and detoxification mechanisms must be exceeded by some critical concentration (threshold) before the health effect is manifested. This threshold view holds that a range of exposures from just above zero to some finite value (i.e., the RfD) can be tolerated by an individual without an appreciable risk of adverse effects.

HQs are summed for all chemical intakes to yield a hazard index (HI) for each exposure pathway. An HI equal to or less than 1 indicates that no adverse noncarcinogenic health effects are expected to occur from cumulative exposure to multiple chemicals and exposure pathways. An HI greater than 1 provides an

indication that such effects may occur, especially in sensitive subpopulation, but does not provide a prediction of the severity or probability of the effects. An HI above 1 indicates the need for further evaluation. For example, effects of different chemicals are not necessarily additive (although the HI approach assumes additivity), nor do all chemicals affect the same target organ. Thus, EPA recommends that if an HI exceeds 1, further evaluation should occur to categorize hazards based on chemical-specific and route-specific toxicity (e.g., which chemicals act on the same target organ, by which route of entry, etc.) (EPA, 1989).

The BHHRA evaluated site-specific exposures based on realistic current and possible future land use. Table 28 provides a summary of the HIs for each scenario using average and RME assumptions for the soil and sediment pathways. None of the HIs for the soil and sediment exposure pathways exceeded EPA's target hazard index of 1. Exposure from the vapor intrusion pathway from PCOCs in groundwater for a hypothetical industrial worker employed in a building sited at the North Area resulted in an HI greater than 1, as shown in Table 27. Detailed spreadsheets containing the risk calculations are provided in Appendix D by scenario.

Hazard Indices were summed for the industrial worker scenario that might be exposed to both soil and vapors emanating from groundwater, as shown in Table 28. The total hazard index for the RME industrial worker at the South Area was 0.09 while the total hazard index for the RME industrial worker at the North Area was 156. The "unacceptable" driver for the industrial worker scenario at the North Area was the inhalation of vapors emanating from groundwater. Hazard indices were not summed for other soil and sediment-based receptors since adding across areas or media would, in fact, "double count" the exposure assumptions nor is it likely or determinable that a receptor will be exposed to multiple media. It would be reasonable to add surface water and sediment exposure for the contact recreation pathway but the surface water pathway was shown to be a *de minimus* risk and screened out as discussed in Section 2.2.

It should be noted that due to lead's unique toxicological properties, noncancer risk estimates could not be calculated similarly to the other noncarcinogenic PCOCs. However, none of the measured concentrations of lead in Site soil samples exceeded EPA's screening level for industrial properties of 800 mg/kg (EPA, 2004a). Thus, it is unlikely that lead at the Site poses an unacceptable risk.

5.3 PATHWAYS QUALITATIVELY EVALUATED (I.E., ELIMINATED DURING SCREENING STEP)

Exposure to surface water by the contact recreation receptor and potential air impacts to off-site residential receptors were qualitatively evaluated in Section 2.2 using a concentration-toxicity screen to eliminate compounds or pathways that were unlikely to present an unacceptable risk. Based on this evaluation, it was concluded that exposure to PCOCs in these media is unlikely to result in an adverse health risk.

5.4 FISH INGESTION PATHWAY

Based on the analytical results for the Intracoastal Waterway sediment samples and in accordance with Section 5.6.8 of the Work Plan, fish tissue samples were collected from four Site zones and one background area within the Intracoastal Waterway. Red drum (*Sciaenops ocellatus*) (6 samples), spotted seatrout (*Cynoscion nebulosus*) (9 samples), southern flounder (*Paralichthys lethostigma*) (9 samples), and blue crab (*Callinectes sapidus*) (9 samples) samples were collected from the Site for laboratory analysis. Samples of these species were also collected from the background area and were archived.

The Site fish tissue samples (fillet samples for finfish, edible tissue for crabs) were analyzed for 12 COIs, based on Intracoastal Waterway sediment data, in accordance with EPA's November 14, 2006 letter. The only COIs with concentrations measured above sample detection limits in any of the 33 samples were silver (detected in four samples), benzo(b)fluoranthene (detected in two samples), and 4,4'-DDE (detected in two samples). The fish tissue data were used to calculate potential risks associated with exposure to Site COIs via the fish ingestion pathway to recreational anglers fishing at the Site, or their families.

This risk assessment (presented in a March 20, 2007 letter to EPA) concluded that the fish ingestion pathway does not pose a human health threat (PBW, 2007). That conclusion was subsequently approved in a June 29, 2007 letter from EPA.

6.0 UNCERTAINTY ASSESSMENT

Uncertainties are inherent in every aspect of a quantitative risk assessment. The inclusion of site-specific factors can decrease uncertainty, although significant uncertainty persists in even the most site-specific risk assessments. Worst-case assumptions and default values, which conform to EPA guidance (EPA, 1989), add conservatism to human health risk assessments. This conservatism is intentionally included in order to tilt the assessment toward over-prediction of risk and hence protection of human health. Therefore, it is important to the risk management decision-making process that the sources of uncertainty are provided.

A careful and comprehensive analysis of the critical areas of uncertainty in a risk assessment is an important part of the risk assessment process. EPA guidance (EPA, 1989) stresses the importance of providing a complete analysis of uncertainties so that risk management decisions take these uncertainties into account when evaluating risk assessment conclusions. The uncertainty analysis provides a context for better understanding the assessment conclusions by identifying the uncertainties that have most significantly affected the assessment results. Therefore, sources of uncertainty in the identification of PCOCs, exposure assessment, and toxicity assessment sections of the risk assessment report are identified and qualitatively evaluated in this section.

6.1 DATA ANALYSIS UNCERTAINTIES

Data collected at the Site satisfied the goals described in the Work Plan (PBW, 2006a) and, thus, adequately characterized the nature and extent of contamination at this Site. As described in the NEDR (PBW, 2009), hundreds of samples of soil, sediment, groundwater and surface water were collected at the South Area, North Area, Intracoastal Waterway, and background soil, sediment, and surface water locations. Characterization was initially conducted for the entire Site and continued at certain areas if a screening level was exceeded.

Overall, the data were determined to be of high quality. Data were collected and analyzed in accordance with approved procedures specified in the FSP (PBW, 2006b) and were validated in accordance with approved validation procedures specified in the QAPP (PBW, 2006c). Very few of the data for any of the analytes were found to be unusable (i.e., "R-flagged"). In instances where data were unusable, the analysis was conducted again (when possible) and the R-flagged data was not used. Some of the data are qualified (i.e., "J-flagged") as estimated because the measured concentration is above the sample

detection limit but below the sample quantitation limit and/or due to minor quality control deficiencies. According to the *Guidance for Data Useability in Risk Assessment (Part A)* (EPA, 1992b), data that are qualified as estimated can be used for risk assessment purposes. Data quality was discussed in greater detail in the NEDR (PBW, 2009).

Compounds were eliminated from further quantitative evaluation in the BHHRA if they were determined to be statistically no different than background concentrations, as summarized in Table 18. While this may result in an underestimation of overall site risks, this approach is appropriate for this Site given that there is no identifiable source of metals at the Site and, regardless, very few inorganic organic compounds were measured above $1/10^{th}$ of their respective screening criteria.

6.2 EXPOSURE ANALYSIS UNCERTAINTIES

The EPA risk assessment guidance for exposure assessments generally requires standard hypothetical exposure scenarios rather than realistic site-specific evaluation of exposure (EPA, 1989), and this conservative default approach was used for the future industrial and construction worker scenarios. Under this approach, if a chemical is found to be present at a site, it is assumed that exposure to that chemical will occur regardless of whether that exposure is realistic or likely. Uncertainties associated with the exposure assessment included calculation of EPCs and selection of exposure parameters. For example, the intake equations are based on several 95^{th} percentile values. When multiplied together, these data compound the uncertainties in the exposure assessments and result in estimated intakes (and resultant cancer risks) that likely estimate exposure well over the 95^{th} percentile.

It is difficult to assess the likelihood of any of the hypothetical future scenarios occurring (i.e., future construction worker or future industrial worker) nor is it possible to know the extent, if any, that trespassers and contact recreation receptors are exposed to PCOCs at the Site. It was assumed that the youth trespasser accesses the Site once a week for twelve years. It was assumed that the contact recreation scenario receptor visits the Site for 39 times per year for 25 years. The exposure assumptions used for all scenarios were chosen to purposefully overestimate exposure in order to err on the side of protection. For the current scenarios (i.e., the youth trespasser and the contact recreation scenario) it appears that these represent a bounding estimate since exposure is likely to be much less.

The screening conducted to evaluate off-site impacts from particulate dust generation and VOC emissions and migration was very conservative because it did not assume any dispersion during transport. Despite that very conservative assumption, no adverse risks to off-site residents were likely.

Soil ingestion rates for adults and older youth are highly uncertain. Because the ingestion rate is a very sensitive parameter in the intake equation, uncertainty and variability in this assumption has a large impact on the dose estimate. This is especially relevant for the construction worker scenario when an enhanced ingestion rate was used. The uncertainty related to this value is tremendous given the study design, small study population, and limited exposure length that are the basis for the soil ingestion rate.

Assumptions regarding bioavailability of metals in soil can significantly influence risk estimates. EPA typically assumes that the bioavailability of compounds from soil is equal to that observed in the toxicity studies used to derive oral toxicity factors but this is most often not the case. Rather, toxicity studies are often, if not always, conducted using a concentration of a compound in either food or water. Bioavailability was assumed to be 100% (i.e., AAF was 1.0) although it is well known that metals and some organic compounds bound to soil are less than 100% bioavailable. This assumption leads to an overestimation of risks, which can be significant.

In the fish tissue risk assessment (PBW, 2007), ingestion rates for finfish were used to represent fish and shellfish ingestion rates, and site-specific fish and crab concentrations were used to estimate exposure. It is unlikely that there is significant uncertainty presented in the fish/shellfish ingestion risk assessment based on the uptake and bioaccumulation differences between crab (a crustacean shellfish) and oysters and clams (molluskan shellfish) since exposure to molluskan shellfish, if harvesting these species were allowed, would be similar if not the same as for the fish and crab (a crustacean shellfish) ingestion pathway

For surface water and groundwater, maximum concentrations were selected as the EPC for purposes of evaluating human health risks. This is likely to be a conservative approach since there were other, lower concentrations, also measured for these media. It is unlikely that surface water concentrations would increase in the future since surface runoff does not appear to be significantly impacting surface water, and impacted groundwater does not discharge to surface water.

6.3 TOXICITY ASSESSMENT UNCERTAINTIES

The studies/basis for the toxicity information and the use of this information generate uncertainty. Toxicity assessments for many of the PCOCs in the BHHRA involve the extrapolation of results from studies on animals. The following are standard assumptions applied by the EPA when extrapolating the results of studies of carcinogenicity in animals to humans.

- Any constituent showing carcinogenic activity in any animal species will also be a human carcinogen.
- There is no threshold dose for carcinogens.
- The results of the most sensitive animal study are appropriate to apply to humans.
- Humans are more sensitive than the most sensitive animal species on a body weight basis.

Uncertainties are introduced in animal to human extrapolation and high to low dose extrapolation. Mathematical models are used by EPA to estimate the possible responses due to exposure to chemicals at levels far below those tested in animals. These models contain several limitations, which should be considered when the results (e.g., risk estimates) are evaluated. Primary among these limitations is the uncertainty in extrapolation of results obtained in animal research to humans and the shortcomings in extrapolating responses obtained from high-dose research studies to estimate responses at very low doses. For example, humans are typically exposed to environmental chemicals at levels that are less than a thousandth of the lowest dose tested in animals. Such doses may be easily degraded or eliminated by physiological internal mechanisms that are present in humans (Ames, 1987).

Additionally, approaches typically used for designating RfDs are highly conservative. For example, EPA (1989) applies a factor of 10 to a No-Observable-Adverse-Effect-Level (NOAEL) for a compound in an animal study for animal-to-human extrapolation. An additional factor of 10 is applied for inter-individual variation in the human population, and additional factors of 10 may be applied to account for limitations in data quality or incomplete studies. Frequently, RfDs are derived from animal studies that have little quantitative bearing on potential adverse effects in humans. Some of this uncertainty may be reduced if the absorption, distribution, metabolic fate, and excretion parameters of a compound are known.

Potential long-term, or chronic, exposures are typically evaluated in risk assessments for Superfund sites, and chronic RfDs and RfCs are the appropriate toxicity criteria to apply to chronic exposure scenarios (chronic exposure is defined in EPA, 1989 as greater than or equal to seven years). The BHHRA includes a construction worker scenario, which was assumed to be of a shorter duration than seven years and is,

therefore, considered a subchronic exposure scenario. In some cases, EPA provides recommended subchronic RfDs which are typically 10 times higher than chronic values. Only chronic toxicity values were used in the risk assessment, which imparts conservatism in the construction worker scenario.

6.4 RISK CHARACTERIZATION UNCERTAINTIES

The only instance where uncertainty may have been introduced into the risk assessment that is not considered conservative was when toxicity values or screening criteria were not available. This was only an issue when evaluating impacts to off-site receptors since there are not inhalation toxicity values for many of the compounds (or TCEQ PCLs) and, as such, a comparison could not be made. It is believed that this is insignificant since: 1) there are few VOCs present in soil at the South Area; 2) the VOCs that are present were measured in low concentrations; and 3) surficial soil testing for lead on Lots 19 and 20 did not suggest that off-site migration via fugitive dust generation was a significant concern.

It was estimated that risks associated with VOC emissions from shallow Zone A groundwater to future inhabitants of buildings were above EPA's target risk goals. It should be noted that this is a highly uncertain pathway with the use of many default assumptions to calculate risks since currently the pathway is incomplete (i.e., there is no building or no worker at the Site 250 days per year for exposure to occur). Likewise, conservative assumptions were made about the slab and slab integrity and contaminant transport in the J&E VIM that would greatly affect the resulting risk estimates. Therefore, it is advisable to consider the results of this analysis in light of the substantial amount of uncertainty in the underlying assumptions of this pathway.

6.5 IMPACT OF UNCERTAINTIES

As described in this section, efforts were made in the BHHRA to purposefully err on the side of conservatism in the absence of site-specific information. It is believed that the overall impact of the uncertainty and conservative nature of the evaluation results in an overly protective assessment. Therefore, for scenarios with risks and HIs within or below the Superfund risk range goal and target HI, it can be said with confidence that these environmental media and areas do not present an unacceptable risk.

7.0 CONCLUSIONS

The primary objective of this BHHRA was to evaluate the possible risks associated with PCOCs in environmental media on human receptors at the Gulfco Marine Maintenance Site. This information will be used to help guide future risk management decisions at the Site. The risk assessment methodology used to conduct this analysis was based on the approach described by EPA in various supplemental and associated guidance documents as documented throughout the report.

Data were segregated by media and by location (e.g., North Area soil and South Area soil; Intracoastal Waterway sediment and wetlands sediment) and distribution testing was performed. Exposure point concentrations were estimated for all PCOCs for both central tendency (average) and RME (95% UCL) exposures using EPA's ProUCL program.

Five different exposure scenarios were quantitatively evaluated for the thirteen different potentially contaminated media identified at the Site. Exposure scenarios were developed to describe current and potential future land use by various human receptors and included a future industrial worker, future construction worker, current youth trespasser, current contact recreation receptor, and current off-site residential receptor. Exposure and risks were calculated for both central tendency and RME scenarios.

Based on the risk estimates and hazard indices shown in Table 28, there were not unacceptable cancer risk or noncancer hazard indices for any of the current or future exposure scenarios except for future exposure to an indoor industrial worker if a building is constructed over impacted groundwater in the North Area. Potential cancer risks in the North Area using maximum shallow Zone A groundwater concentrations and the J&E VIM were predicted to be greater than 1×10^{-4} while the HIs were estimated to be greater than 1. It should be noted that this scenario was evaluated despite the current restrictive covenant on Lots 55, 56, and 57 that require future building design to preclude vapor intrusion, which would effectively make this pathway incomplete. Estimated risks from Zone A groundwater at the South Area were below EPA's goals and, therefore, adverse risks associated with the vapor intrusion pathway are unlikely in this area.

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TABLE 1
EXPOSURE POINT CONCENTRATIONS (mg/kg)
SOUTH AREA SURFACE SOIL*

Chemical of Interest*	Average	Max Detection	Min Detection	$^{Tot}Soil_{Comb}$ (1)	EPA Region 6 Soil Screening Criteria (2)		95% UCL	Statistic Used (3)	# of Detects/# of Samples
2-Methylnaphthalene	2.97E-02	5.01E-01	1.06E-02	2.48E+03	---		7.90E-02	97.5% KM (Chebyshev)	22 of 83
4,4'-DDD	3.07E-03	2.43E-02	2.64E-03	1.04E+02	1.10E+01	<	2.70E-04	median	5 of 83
4,4'-DDE	1.92E-03	6.93E-02	4.28E-04	7.32E+01	7.80E+00		7.52E-03	97.5% KM (Chebyshev)	17 of 83
4,4'-DDT	3.89E-03	6.25E-02	2.81E-04	6.84E+01	7.80E+00		1.03E-02	97.5% KM (Chebyshev)	37 of 83
Acenaphthene	6.08E-02	1.69E+00	1.13E-02	3.72E+04	3.30E+04		2.00E-01	97.5% KM (Chebyshev)	26 of 83
Acenaphthylene	4.55E-02	9.35E-01	1.84E-02	3.72E+04	---		1.21E-01	97.5% KM (Chebyshev)	19 of 83
Aluminum	**5.34E+03**	**1.52E+04**	**4.14E+02**	**5.70E+05**	**1.00E+05**		**5.95E+03**	**95% Student's-t**	**83 of 83**
Anthracene	9.71E-02	2.46E+00	1.12E-02	1.86E+05	1.00E+05		2.99E-01	97.5% KM (Chebyshev)	37 of 83
Antimony	1.65E+00	5.14E+00	2.00E-01	3.06E+02	4.50E+02		2.24E+00	97.5% KM (Chebyshev)	72 of 83
Aroclor-1254	**1.46E-01**	**7.98E+00**	**3.34E-03**	**7.10E+00**	**8.30E-01**		**7.64E-01**	**97.5% KM (Chebyshev)**	**13 of 85**
Arsenic	**3.74E+00**	**2.43E+01**	**2.60E-01**	**1.96E+02**	**1.80E+00**		**6.49E+00**	**97.5% KM (Chebyshev)**	**71 of 83**
Barium	3.45E+02	2.18E+03	1.86E+01	8.90E+04	7.90E+04		5.84E+02	97.5% KM (Chebyshev)	83 of 83
Benzo(a)anthracene	**3.57E-01**	**5.02E+00**	**2.86E-02**	**2.36E+01**	**2.30E+00**		**9.03E-01**	**97.5% KM (Chebyshev)**	**30 of 83**
Benzo(a)pyrene	**4.53E-01**	**4.57E+00**	**1.03E-02**	**2.37E+00**	**2.30E-01**		**1.09E+00**	**97.5% KM (Chebyshev)**	**65 of 83**
Benzo(b)fluoranthene	**5.88E-01**	**5.42E+00**	**4.08E-02**	**2.36E+01**	**2.30E+00**		**1.10E+00**	**95% KM (Chebyshev)**	**61 of 83**
Benzo(g,h,i)perylene	3.04E-01	4.24E+00	9.89E-03	1.86E+04	---		7.89E-01	97.5% KM (Chebyshev)	51 of 83
Benzo(k)fluoranthene	**2.44E-01**	**4.25E+00**	**1.95E-02**	**2.37E+02**	**2.30E+01**		**6.58E-01**	**97.5% KM (Chebyshev)**	**33 of 83**
Beryllium	4.08E-01	4.60E+00	1.40E-02	2.47E+02	2.20E+03		7.68E-01	97.5% KM (Chebyshev)	82 of 83
Boron	5.56E+00	5.44E+01	2.43E+00	1.90E+05	1.00E+05		7.07E+00	97.5% KM (Bootstrap)	34 of 83
Butyl Benzyl Phthalate	1.90E-02	2.97E-01	1.29E-02	1.00E+04	2.40E+02	<	1.25E-02	median	6 of 83
Cadmium	4.69E-01	9.71E+00	2.30E-02	8.52E+02	5.60E+02		1.25E+00	97.5% KM (Chebyshev)	50 of 83
Carbazole	6.20E-02	1.54E+00	1.04E-02	9.54E+02	9.60E+01		1.95E-01	97.5% KM (Chebyshev)	29 of 83
Chromium	**1.61E+01**	**1.36E+02**	**3.37E+00**	**5.71E+04**	**5.00E+02**		**2.68E+01**	**97.5% Chebyshev**	**83 of 83**
Chrysene	4.09E-01	4.87E+00	9.32E-03	2.36E+03	2.30E+02		9.84E-01	97.5% KM (Chebyshev)	56 of 83
Cobalt	3.71E+00	1.60E+01	4.90E-02	2.70E+02	2.10E+03		5.25E+00	97.5% KM (Chebyshev)	82 of 83
Copper	2.80E+01	2.16E+02	1.55E+00	3.69E+04	4.20E+04		5.22E+01	97.5% KM (Chebyshev)	83 of 83
Dibenz(a,h)anthracene	**1.87E-01**	**1.64E+00**	**6.39E-02**	**2.37E+00**	**2.30E-01**		**2.45E-01**	**95% KM (Bootstrap)**	**36 of 83**
Dibenzofuran	3.41E-02	8.21E-01	1.67E-02	2.73E+03	1.70E+03		7.23E-02	95% KM (BCA)	17 of 83
Dieldrin	**1.40E-03**	**2.05E-02**	**2.43E-04**	**1.14E+00**	**1.20E-01**		**3.14E-03**	**97.5% KM (Chebyshev)**	**21 of 83**
Di-n-butyl Phthalate	9.38E-02	7.53E-01	3.68E-02	1.62E+04	6.80E+04		1.25E-01	97.5% KM (Chebyshev)	9 of 83
Endosulfan Sulfate	2.09E-03	7.13E-02	4.56E-04	4.09E+03	---		4.21E-03	95% KM (BCA)	17 of 83
Endrin Aldehyde	8.82E-03	7.38E-02	4.97E-04	2.04E+02	---		8.72E-03	97.5% KM (Chebyshev)	22 of 83
Endrin Ketone	2.25E-03	2.00E-02	4.69E-04	1.77E+02	---		4.41E-03	97.5% KM (Chebyshev)	18 of 83
Fluoranthene	8.00E-01	1.42E+01	1.33E-02	2.48E+04	2.40E+04		2.14E+00	97.5% KM (Chebyshev)	59 of 83
Fluorene	5.18E-02	1.11E+00	9.45E-03	2.48E+04	2.60E+04		1.57E-01	97.5% KM (Chebyshev)	28 of 83
gamma-Chlordane	1.23E-03	1.56E-02	7.10E-04	5.10E+01	---		2.90E-03	97.5% KM (Chebyshev)	8 of 83
Indeno(1,2,3-cd)pyrene	**4.83E-01**	**6.49E+00**	**6.34E-02**	**2.37E+01**	**2.30E+00**		**9.31E-01**	**95% KM (Chebyshev)**	**63 of 83**
Iron	**1.63E+04**	**7.71E+04**	**3.45E+03**	---	**1.00E+05**		**2.40E+04**	**97.5% Chebyshev**	**83 of 83**
Lead	**6.96E+01**	**6.43E+02**	**2.82E+00**	**1.60E+03**	**8.00E+02**		**1.47E+02**	**97.5% Chebyshev**	**83 of 83**
Lithium	7.86E+00	2.80E+01	6.50E-01	1.90E+03	2.30E+04		1.18E+01	97.5% Chebyshev	83 of 83
Manganese	2.57E+02	8.92E+02	5.93E+01	2.41E+04	3.50E+04		2.81E+02	95% Student's-t	83 of 83
Mercury	**2.22E-02**	**6.60E-01**	**3.20E-03**	**3.26E+00**	**3.40E+02**		**7.42E-02**	**97.5% KM (Chebyshev)**	**37 of 83**
Molybdenum	1.32E+00	8.42E+00	9.80E-02	4.51E+03	5.70E+03		2.40E+00	97.5% KM (Chebyshev)	71 of 83
Nickel	1.16E+01	3.67E+01	2.84E+00	7.94E+03	2.30E+04		1.50E+01	97.5% KM (Chebyshev)	83 of 83
Phenanthrene	5.13E-01	1.26E+01	1.39E-02	1.86E+04	---		1.06E+04	97.5% KM (Chebyshev)	57 of 83
Pyrene	5.32E-01	8.47E+00	1.21E-02	1.86E+04	3.20E+04		1.36E+00	97.5% KM (Chebyshev)	57 of 83
Strontium	7.06E+01	5.27E+02	1.65E+01	4.91E+05	1.00E+05		1.01E+02	95% Chebyshev	83 of 83
Tin	8.06E-01	4.95E+00	5.20E-01	3.97E+05	---		1.31E+00	97.5% KM (Chebyshev)	23 of 83
Titanium	2.98E+01	6.45E+02	1.15E+01	1.00E+06	---		6.30E+01	95% Chebyshev	83 of 83
Vanadium	1.38E+01	4.56E+01	5.42E+00	2.29E+03	1.10E+03		1.80E+01	97.5% Chebyshev	83 of 83
Zinc	6.01E+02	4.77E+03	1.23E+01	2.45E+05	1.00E+05		1.06E+03	97.5% Chebyshev	81 of 83

Notes:

* Surface soil was collected from 0 to 0.5 ft. below ground surface.

+ Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

(1) - $^{Tot}Soil_{Comb}$ PCL = TCEQ protective concentration Level for 30 acre source area Commercial/Industrial total soil combined pathway (includes inhalation; ingestion; dermal pathways).

(2) - From EPA's "Region 6 Human Health Medium-Specific Screening Levels 2004-2005". Industrial Outdoor Worker.

(3) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 2
EXPOSURE POINT CONCENTRATIONS (mg/kg)
SOUTH AREA SOIL*

Chemical of Interest+	Average	Max Detection	Min Detection	$^{Tot}Soil_{Comb}$ (1)	EPA Region 6 Soil Screening Criteria (2)		95% UCL	Statistic Used (3)	# of Detects/# of Samples
1,3,5-Trimethylbenzene	9.89E-02	4.36E+00	2.67E-04	8.32E+01	7.80E+01		5.56E-01	97.5% KM (Chebyshev)	9 of 83
2-Butanone	3.29E-03	2.26E-02	9.92E-04	7.26E+04	3.40E+04		4.14E-03	95% KM (Bootstrap)	4 of 83
2-Hexanone	1.65E-03	2.07E-02	1.09E-03	7.92E+01	---		3.63E-02	97.5% KM (Chebyshev)	8 of 83
2-Methylnaphthalene	6.97E-02	7.21E+00	1.06E-02	2.48E+03	---		1.60E-01	95% KM (BCA)	32 of 166
4,4'-DDD	**7.76E-03**	**1.12E+00**	**3.69E-04**	**1.04E+02**	**1.10E+01**		**5.08E-02**	**97.5% KM (Chebyshev)**	**21 of 166**
4,4'-DDE	1.58E-03	6.93E-02	4.28E-04	7.32E+01	7.80E+00		2.81E-03	95% KM (BCA)	22 of 166
4,4'-DDT	3.75E-03	1.13E-01	2.81E-04	6.84E+01	7.80E+00		9.27E-03	97.5% KM (Chebyshev)	68 of 166
Acenaphthene	4.33E-02	1.69E+00	1.13E-02	3.72E+04	3.30E+04		1.16E-01	97.5% KM (Chebyshev)	35 of 166
Acenaphthylene	4.84E-02	1.20E+00	1.72E-02	3.72E+04	---		7.19E-02	95% KM (BCA)	37 of 166
Acetone	3.70E-02	1.60E-01	3.10E-02	8.11E+03	1.00E+05		5.41E-02	97.5% KM (Chebyshev)	10 of 83
Aluminum	**6.45E+03**	**1.57E+04**	**4.14E+02**	**5.70E+05**	**1.00E+05**		**8.20E+03**	**97.5% Chebyshev**	**166 of 166**
Anthracene	8.89E-02	2.46E+00	1.12E-02	1.86E+05	1.00E+05		1.24E-01	95% KM (BCA)	65 of 166
Antimony	1.45E+00	5.51E+00	2.00E-01	3.06E+02	4.50E+02		1.87E+00	97.5% KM (Chebyshev)	144 of 166
Aroclor-1254	**2.16E-01**	**1.15E+01**	**3.34E-03**	**7.10E+00**	**8.30E-01**		**7.73E-01**	**97.5% KM (Chebyshev)**	**25 of 170**
Arsenic	**3.33E+00**	**2.43E+01**	**2.30E-01**	**1.96E+02**	**1.80E+00**		**4.92E+00**	**97.5% KM (Chebyshev)**	**139 of 166**
Barium	2.37E+02	2.18E+03	1.86E+01	8.90E+04	7.90E+04		3.30E+02	95% Chebyshev	166 of 166
Benzene	3.89E-03	2.21E-02	3.39E-04	1.11E+02	1.60E+00		6.09E-03	97.5% KM (Chebyshev)	72 of 83
Benzo(a)anthracene	**2.69E-01**	**5.02E+00**	**1.18E-02**	**2.36E+01**	**2.30E+00**		**6.43E-01**	**97.5% KM (Chebyshev)**	**44 of 166**
Benzo(a)pyrene	**3.48E-01**	**4.88E+00**	**9.99E-03**	**2.37E+00**	**2.30E-01**		**7.63E-01**	**97.5% KM (Chebyshev)**	**113 of 166**
Benzo(b)fluoranthene	**4.77E-01**	**5.97E+00**	**4.08E-02**	**2.36E+01**	**2.30E+00**		**8.22E-01**	**95% KM (Chebyshev)**	**102 of 166**
Benzo(g,h,i)perylene	2.17E-01	4.24E+00	9.89E-03	1.86E+04	---		4.94E-01	97.5% KM (Chebyshev)	81 of 166
Benzo(k)fluoranthene	**1.58E-01**	**4.25E+00**	**1.58E-02**	**2.37E+02**	**2.30E+01**		**3.81E-01**	**97.5% KM (Chebyshev)**	**45 of 166**
Beryllium	4.65E-01	4.60E+00	1.40E-02	2.47E+02	2.20E+03		5.25E-01	95% KM (BCA)	165 of 166
Boron	5.68E+00	5.44E+01	2.43E+00	1.92E+05	1.00E+05		6.51E+00	95% KM (Bootstrap)	72 of 166
Butyl Benzyl Phthalate	2.01E-02	6.17E-01	1.29E-02	1.00E+04	2.40E+02		4.72E-02	97.5% KM (Chebyshev)	10 of 166
Cadmium	3.40E-01	9.71E+00	2.30E-02	8.52E+02	5.60E+02		4.67E-01	95% KM (Bootstrap)	93 of 166
Carbazole	4.64E-02	1.54E+00	1.04E-02	9.54E+02	9.60E+01		1.19E-01	97.5% KM (Chebyshev)	42 of 166
Carbon Disulfide	1.67E-03	2.80E-02	9.87E-04	7.19E+03	7.20E+02		3.92E-03	97.5% KM (Chebyshev)	13 of 83
Chromium	**1.35E+01**	**1.36E+02**	**2.03E+00**	**5.71E+04**	**5.00E+02**		**1.78E+01**	**95% Chebyshev**	**166 of 166**
Chrysene	3.28E-01	4.87E+00	9.01E-03	2.36E+03	2.30E+02		7.12E-01	97.5% KM (Chebyshev)	93 of 166
Cobalt	4.11E+00	1.60E+01	4.90E-02	2.70E+02	2.10E+03		4.35E+00	95% Winsor-t	165 of 166
Copper	2.43E+01	4.87E+02	1.30E-01	3.69E+04	4.20E+04		4.01E+01	95% KM (Chebyshev)	164 of 166
Cyclohexane	2.65E-01	2.17E+01	6.26E-04	4.20E+04	6.80E+03		1.91E+00	97.5% KM (Chebyshev)	47 of 83
Dibenz(a,h)anthracene	**1.48E-01**	**1.64E+00**	**6.19E-02**	**2.37E+00**	**2.30E-01**		**1.80E-01**	**95% KM (Bootstrap)**	**56 of 166**
Dibenzofuran	3.34E-02	8.21E-01	1.67E-02	2.73E+03	1.70E+03		7.31E-02	97.5% KM (Chebyshev)	23 of 166
Dieldrin	**8.89E-04**	**2.05E-02**	**2.43E-04**	**1.14E+00**	**1.20E-01**		**2.11E-03**	**97.5% KM (Chebyshev)**	**33 of 166**
Di-n-butyl Phthalate	4.18E-02	7.53E-01	3.11E-02	1.62E+04	6.80E+04		7.65E-02	97.5% KM (Chebyshev)	11 of 166
Endosulfan Sulfate	1.27E-03	7.13E-02	7.13E-02	4.09E+03	---		2.30E-03	95% KM (BCA)	21 of 166
Endrin Aldehyde	2.01E-03	7.38E-02	4.97E-04	2.04E+02	---		3.54E-03	95% KM (BCA)	31 of 166
Endrin Ketone	1.35E-03	2.00E-02	4.69E-04	1.77E+02	---		2.53E-03	97.5% KM (Chebyshev)	25 of 166
Ethylbenzene	3.40E-03	1.05E-01	6.54E-04	1.00E+04	2.30E+02		5.91E-03	95% KM (Bootstrap)	47 of 83
Fluoranthene	5.95E-01	1.42E+01	1.33E-02	2.48E+04	2.40E+04		1.41E+00	97.5% KM (Chebyshev)	96 of 166
Fluorene	4.44E-02	1.11E+00	9.45E-03	2.48E+04	2.60E+04		1.07E-01	97.5% KM (Chebyshev)	41 of 166
gamma-Chlordane	9.98E-04	1.56E-02	7.10E-04	5.10E+01	---		1.84E-03	97.5% KM (Chebyshev)	12 of 166
Indeno(1,2,3-cd)pyrene	**3.85E-01**	**6.49E+00**	**5.74E-02**	**2.37E+01**	**2.30E+00**		**6.58E-01**	**95% KM (Chebyshev)**	**104 of 166**
Iron	**1.43E+04**	**7.71E+04**	**2.41E+03**	**---**	**1.00E+05**		**1.75E+04**	**95% Chebyshev**	**166 of 166**
Isopropylbenzene (cumene)	**8.31E-01**	**6.49E+01**	**3.18E-04**	**6.25E+03**	**5.80E+02**		**5.85E+00**	**97.5% KM (Chebyshev)**	**16 of 83**
Lead	**5.35E+01**	**7.02E+02**	**2.48E+00**	**1.60E+03**	**8.00E+02**		**1.04E+02**	**97.5% Chebyshev**	**166 of 166**
Lithium	1.00E+01	2.86E+01	6.50E-01	1.90E+03	2.30E+04		1.22E+01	95% Chebyshev	166 of 166
m,p-Xylene	3.43E-02	2.56E+00	5.58E-04	6.50E+03	2.10E+02		1.69E-01	95% KM (Chebyshev)	53 of 83
Manganese	2.61E+02	8.92E+02	5.93E+01	2.41E+04	3.50E+04		2.78E+02	95% Student's-t	166 of 166
Mercury	**2.56E-02**	**8.50E-01**	**2.60E-03**	**3.26E+00**	**3.40E+02**		**4.00E-02**	**95%KM (BCA)**	**73 of 166**
Methylcyclohexane	3.66E-02	2.73E+00	2.23E-04	3.29E+04	1.40E+02		1.80E-01	95% KM (Chebyshev)	57 of 83
Molybdenum	9.05E-01	1.04E+01	8.80E-02	4.51E+03	5.70E+03		1.62E+00	97.5% KM (Chebyshev)	118 of 166
Naphthalene	**3.26E-01**	**1.92E+01**	**4.82E-03**	**1.90E+02**	**2.10E+02**	**<**	**2.65E-03**	**median**	**8 of 83**
Nickel	1.17E+01	3.67E+01	2.70E+00	7.94E+03	2.30E+04		1.24E+01	95% Student's-t	166 of 166
n-Propylbenzene	2.37E-02	1.80E+00	2.30E-04	4.10E+03	2.40E+02		1.63E-01	97.5% KM (Chebyshev)	14 of 83
o-Xylene	1.30E-02	8.40E-01	2.23E-04	8.00E+03	2.80E+02		7.75E-02	97.5% KM (Chebyshev)	32 of 83
Phenanthrene	4.02E-01	1.26E+01	1.36E-02	1.86E+04	---		9.99E-01	97.5% KM (Chebyshev)	95 of 166
Pyrene	4.32E-01	8.47E+00	1.21E-02	1.86E+04	3.20E+04		9.71E-01	97.5% KM (Chebyshev)	98 of 166
Strontium	7.56E+01	5.91E+02	1.65E+01	4.91E+05	1.00E+05		1.01E+02	95% Chebyshev	166 of 166
Tin	8.11E-01	6.48E+00	5.20E-01	3.97E+05	---		1.20E+00	97.5% KM (Chebyshev)	40 of 166
Titanium	2.58E+01	6.45E+02	4.02E+00	1.00E+06	---		3.22E+01	95% Student's-t	166 of 166
Toluene	3.99E-03	1.92E-02	7.21E-04	2.90E+04	5.20E+02		6.04E-03	97.5% KM (Chebyshev)	69 of 83
Vanadium	1.44E+01	4.56E+01	4.73E+00	2.29E+03	1.10E+03		1.73E+01	97.5% Chebyshev	166 of 166
Xylene (total)	4.73E-02	3.40E+00	7.77E-04	6.50E+03	2.10E+02		3.04E-01	97.5% KM (Chebyshev)	53 of 83
Zinc	4.34E+02	7.65E+03	6.17E+00	2.45E+05	1.00E+05		8.15E+02	97.5% Chebyshev	166 of 166

Notes:

* Soil was collected from 0 to 4 ft. below ground surface.

+ Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

(1) - $^{Tot}Soil_{Comb}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Commercial/Industrial total soil combined pathway (includes inhalation; ingestion; dermal pathways).

(2) - From EPA's "Region 6 Human Health Medium-Specific Screening Levels 2004-2005". Industrial Outdoor Worker.

(3) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 3
EXPOSURE POINT CONCENTATIONS (mg/L)
SOUTH AREA ZONE A GROUNDWATER

Chemical of Interest[+]	Average		RME EPC [(1)]	Notes:	# of Detects/# of Samples
1,1,1-Trichloroethane	1.85E-04		1.40E-03	RME EPC is max detect	1 of 13
1,1-Dichloroethane	2.10E-03		1.50E-02	RME EPC is max detect	3 of 13
2-Butanone	4.30E-04		3.00E-03	RME EPC is max detect	1 of 13
2-Methylnaphthalene	7.76E-04		8.80E-03	RME EPC is max detect	1 of 13
4,4'-DDE	3.34E-06		1.00E-05	RME EPC is max detect	1 of 13
Acetophenone	3.72E-03		4.60E-02	RME EPC is max detect	1 of 13
Acrylonitrile	1.00E-03		6.50E-03	RME EPC is max detect	1 of 13
Aluminum	7.13E-01		7.52E+00	RME EPC is max detect	7 of 13
Antimony	1.02E-02		4.30E-02	RME EPC is max detect	8 of 13
Arsenic	1.61E-02		5.70E-02	RME EPC is max detect	2 of 13
Barium	9.88E-02		2.20E-01	RME EPC is max detect	13 of 13
Benzene	4.25E-04		4.20E-03	RME EPC is max detect	1 of 13
Benzo(a)pyrene	1.06E-04		6.00E-04	RME EPC is max detect	1 of 13
Benzo(b)fluoranthene	3.26E-04		2.80E-03	RME EPC is max detect	1 of 13
Benzo(g,h,i)perylene	2.11E-04		1.60E-03	RME EPC is max detect	1 of 13
Benzoic Acid	8.40E-04		1.20E-03	RME EPC is max detect	8 of 13
Bis(2-ethylhexyl)Phthalate	1.46E-03		6.00E-04	RME EPC is max detect*	2 of 13
Boron	2.67E+00		4.04E+00	RME EPC is max detect	13 of 13
Carbazole	7.00E-04		8.40E-03	RME EPC is max detect	1 of 13
Carbon Disulfide	6.50E-05		3.00E-04	RME EPC is max detect	1 of 13
Chromium	5.53E-02		1.50E-01	RME EPC is max detect	13 of 13
Chrysene	1.93E-04		6.00E-04	RME EPC is max detect	1 of 13
cis-1,2-Dichloroethene	3.27E-03		3.00E-02	RME EPC is max detect	4 of 13
Cobalt	3.06E-03		8.90E-03	RME EPC is max detect	7 of 13
Cyclohexane	6.09E-04		6.80E-03	RME EPC is max detect	1 of 13
Dibenz(a,h)anthracene	2.90E-04		2.10E-03	RME EPC is max detect	1 of 13
Di-n-octyl Phthalate	2.08E-04		7.00E-04	RME EPC is max detect	1 of 13
Endosulfan II	5.61E-06		3.10E-05	RME EPC is max detect	1 of 14
Endosulfan Sulfate	8.57E-06		1.00E-04	RME EPC is max detect	1 of 14
Endrin Ketone	3.74E-06		2.30E-05	RME EPC is max detect	1 of 13
Fluorene	1.84E-04		1.00E-03	RME EPC is max detect	1 of 13
gamma-BHC (Lindane)	7.66E-06		4.20E-05	RME EPC is max detect	2 of 14
Heptachlor Epoxide	5.07E-06		2.01E-05	RME EPC is max detect	1 of 14
Indeno(1,2,3-cd)pyrene	2.92E-04		2.40E-03	RME EPC is max detect	1 of 13
Iron	6.39E+00		2.52E+01	RME EPC is max detect	13 of 13
Isopropylbenzene (Cumene)	1.78E-04		1.60E-03	RME EPC is max detect	1 of 13
Lithium	3.61E-01		6.60E-01	RME EPC is max detect	13 of 13
m,p-Cresol	1.10E-03		8.20E-03	RME EPC is max detect	1 of 13
Manganese	4.15E+00		1.28E+01	RME EPC is max detect	13 of 13
Molybdenum	2.30E-03		2.00E-03	RME EPC is max detect	1 of 13
MTBE	3.90E-03		3.20E-02	RME EPC is max detect	3 of 13
Nickel	7.40E-03		2.20E-02	RME EPC is max detect	10 of 14
o-Cresol	4.47E-04		4.40E-03	RME EPC is max detect	1 of 13
Phenanthrene	2.12E-04		1.60E-03	RME EPC is max detect	1 of 13
Selenium	9.08E-03		3.80E-02	RME EPC is max detect	2 of 13
Silver	7.38E-03		9.46E+00	RME EPC is max detect	12 of 13
Strontium	9.03E+00		1.71E+01	RME EPC is max detect	13 of 13
Thallium	2.00E-03		7.30E-03	RME EPC is max detect	1 of 13
Titanium	5.30E-03		3.10E-02	RME EPC is max detect	7 of 13
Vanadium	8.56E-03		2.30E-02	RME EPC is max detect	7 of 13
Vinyl Chloride	1.85E-04		1.90E-03	RME EPC is max detect	1 of 13

Notes:
*The maximum detected value is sometimes lower than the average since 1/2 of the reporting limit was used as a proxy value when it was not detected and because J flagged data (estimated) were used in the risk assessment.
[+] Chemicals of interest are any chemical measured in at least one sample.
[(1)] RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 4
EXPOSURE POINT CONCENTRATIONS (mg/L)
INTRACOASTAL WATERWAY SURFACE WATER (TOTAL)

Chemical of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{Comb}$ (1)	^{SW}RBELs Saltwater Fish Only (1)	RME EPC (2)	Statistic Used	# of Detects/# of Samples
Acrylonitrile	9.38E-04	2.10E-03	2.10E-03	7.57E-02	7.30E-03	2.10E-03	RME EPC is max detect	1 of 4
Aluminum	4.05E-01	5.50E-01	2.80E-01	4.03E+02	---	5.50E-01	RME EPC is max detect	4 of 4
Barium	2.40E-02	2.60E-02	2.20E-02	6.49E+01	---	2.60E-02	RME EPC is max detect	4 of 4
Boron	4.69E+00	4.81E+00	4.60E+00	7.44E+01	---	4.81E+00	RME EPC is max detect	4 of 4
Chromium	7.98E-02	1.20E-01	7.00E-02	1.26E+02	2.22E+00	1.20E-01	RME EPC is max detect	4 of 4
Copper	6.53E-03	1.10E-02	9.10E-03	3.31E+01	---	1.10E-02	RME EPC is max detect	2 of 4
Iron	4.63E-01	5.90E-01	3.20E-01	---	---	5.90E-01	RME EPC is max detect	4 of 4
Lithium	2.53E-01	2.70E-01	2.20E-01	1.65E+01	---	2.70E-01	RME EPC is max detect	4 of 4
Manganese	4.03E-02	4.80E-02	3.30E-02	4.09E+01	1.00E-01	4.80E-02	RME EPC is max detect	4 of 4
Silver	2.80E-03	3.70E-03	2.80E-03	1.57E+00	---	3.70E-03	RME EPC is max detect	3 of 4
Strontium	7.22E+00	7.35E+00	6.95E+00	3.38E+02	---	7.35E+00	RME EPC is max detect	4 of 4
Titanium	3.90E-03	5.70E-03	2.00E-03	8.67E+04	---	5.70E-03	RME EPC is max detect	4 of 4
Vanadium	4.25E-02	6.10E-02	3.50E-02	1.08E+00	---	6.10E-02	RME EPC is max detect	4 of 4

INTRACOASTAL WATERWAY SURFACE WATER (DISSOLVED METALS)

Chemicals of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{Comb}$ (1)	^{SW}RBELs Saltwater Fish Only (1)	RME EPC	Statistic Used	# of Detects/# of Samples
Aluminum	6.48E-02	4.70E-02	4.70E-02	4.03E+02	---	4.70E-02	RME EPC is max detect	1 of 4
Barium	2.63E-02	2.80E-02	2.30E-02	6.49E+01	---	2.80E-02	RME EPC is max detect	4 of 4
Boron	4.79E+00	4.99E+00	4.30E+00	7.44E+01	---	4.99E+00	RME EPC is max detect	4 of 4
Lithium	2.10E-01	2.20E-01	2.00E-01	1.65E+01	---	2.20E-01	RME EPC is max detect	4 of 4
Manganese	4.85E-03	6.00E-03	2.50E-03	4.09E+01	1.00E-01	6.00E-03	RME EPC is max detect	4 of 4
Nickel	2.63E-03	3.30E-03	1.30E-03	1.13E+00	4.60E+00	3.30E-03	RME EPC is max detect	4 of 4
Selenium	4.25E-02	6.30E-02	2.80E-02	4.13E+00	4.20E+00	6.30E-02	RME EPC is max detect	4 of 4
Strontium	8.04E+00	8.47E+00	7.36E+00	3.38E+02	---	8.47E+00	RME EPC is max detect	4 of 4

Notes:
* Chemicals of interest are any chemical measured in at least one sample.
(1) - TRRP 24. TCEQ, March 31, 2006.
(2) RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 5
EXPOSURE POINT CONCENTRATIONS (mg/L)
INTRACOASTAL WATERWAY BACKGROUND SURFACE WATER (TOTAL)

Chemical of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{comb}$ [1]	^{SW}RBELs Saltwater Fish Only [1]	RME EPC [2]	Statistic Used	# of Detects/# of Samples
4,4'-DDD	**3.30E-06**	**7.62E-06**	**3.60E-06**	---	**7.00E-06**	**7.62E-06**	**RME EPC is max detect**	**2 of 4**
4,4'-DDT	**4.93E-06**	**1.30E-05**	**1.30E-05**	---	**5.00E-06**	**1.30E-05**	**RME EPC is max detect**	**1 of 4**
Acetone	1.47E-03	4.52E-03	4.52E-03	7.80E+02	---	4.52E-03	RME EPC is max detect	1 of 4
Aldrin	**9.24E-06**	**1.10E-05**	**4.40E-06**	---	**2.80E-06**	**1.10E-05**	**RME EPC is max detect**	**4 of 4**
Aluminum	2.44E-01	4.00E-01	2.10E-01	4.03E+02	---	4.00E-01	RME EPC is max detect	4 of 4
Barium	1.96E-02	2.00E-02	2.00E-02	6.49E+01	---	2.00E-02	RME EPC is max detect	4 of 4
Benzo(g,h,i)perylene	1.20E-04	2.02E-04	2.02E-04	---	---	2.02E-04	RME EPC is max detect	1 of 4
Benzo(k)fluoranthene	**1.73E-04**	**3.11E-04**	**3.11E-04**	---	**1.80E-04**	**3.11E-04**	**RME EPC is max detect**	**1 of 4**
Bis(ethylhexyl) Phthalate	4.17E-03	1.97E-02	1.94E-02	---	2.20E-02	1.97E-02	RME EPC is max detect	2 of 4
Boron	4.38E+00	4.50E+00	4.27E+00	7.44E+01	---	4.50E+00	RME EPC is max detect	4 of 4
Chromium	7.84E-02	7.90E-02	7.80E-02	1.26E+02	2.22E+00	7.90E-02	RME EPC is max detect	4 of 4
Chromium VI	6.20E-03	1.10E-02	1.10E-02	2.43E-01	---	1.10E-02	RME EPC is max detect	1 of 4
Chrysene	1.61E-04	3.68E-04	3.68E-04	---	5.40E-03	3.68E-04	RME EPC is max detect	1 of 4
Di-n-butyl Phthalate	6.70E-04	1.42E-03	8.28E-04	4.49E+00	---	1.42E-03	RME EPC is max detect	2 of 4
Di-n-octyl Phthalate	2.65E-04	6.50E-04	6.50E-04	---	---	6.50E-04	RME EPC is max detect	1 of 4
Iron	3.40E-01	4.30E-01	3.40E-01	---	---	4.30E-01	RME EPC is max detect	4 of 4
Lithium	3.00E-01	3.40E-01	2.70E-01	1.65E+01	---	3.40E-01	RME EPC is max detect	4 of 4
Manganese	3.60E-02	4.10E-02	3.40E-02	4.09E+01	1.00E-01	4.10E-02	RME EPC is max detect	4 of 4
Methoxyclor	3.66E-06	1.40E-05	1.40E-05	7.19E-02	1.48E-03	1.40E-05	RME EPC is max detect	1 of 4
Molybdenum	2.72E-03	4.20E-03	1.80E-03	3.47E+00	---	4.20E-03	RME EPC is max detect	2 of 4
Silver	5.43E-03	5.90E-03	4.70E-03	1.57E+00	---	5.90E-03	RME EPC is max detect	4 of 4
Strontium	7.76E+00	8.31E+00	7.31E+00	3.38E+02	---	8.31E+00	RME EPC is max detect	4 of 4
Titanium	2.98E-03	4.20E-03	2.40E-03	8.67E+04	---	4.20E-03	RME EPC is max detect	4 of 4
Vanadium	4.14E-02	3.70E-02	1.10E-02	1.08E+00	---	3.70E-02	RME EPC is max detect	4 of 4

INTRACOASTAL WATERWAY BACKGROUND SURFACE WATER (DISSOLVED METALS)

Chemicals of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{comb}$ [1]	^{SW}RBELs Saltwater Fish Only [1]	RME EPC	Statistic Used	# of Detects/# of Samples
Barium	1.65E-02	1.90E-02	1.20E-02	6.49E+01	---	1.90E-02	RME EPC is max detect	4 of 4
Boron	3.98E+00	4.33E+00	3.04E+00	7.44E+01	---	4.33E+00	RME EPC is max detect	4 of 4
Chromium	7.38E-02	7.80E-02	6.40E-02	1.26E+02	2.22E+00	7.80E-02	RME EPC is max detect	4 of 4
Iron	5.40E-02	6.00E-02	6.00E-02	---	---	6.00E-02	RME EPC is max detect	1 of 4
Lithium	2.90E-01	3.90E-01	1.90E-01	1.65E+01	---	3.90E-01	RME EPC is max detect	4 of 4
Manganese	1.53E-02	1.80E-02	1.10E-02	4.09E+01	1.00E-01	1.80E-02	RME EPC is max detect	4 of 4
Molybdenum	3.68E-03	3.90E-03	3.90E-03	3.47E+00	---	3.90E-03	RME EPC is max detect	1 of 4
Silver	5.23E-03	5.80E-03	4.30E-03	1.57E+00	---	5.80E-03	RME EPC is max detect	4 of 4
Strontium	6.84E+00	7.46E+00	5.20E+00	3.38E+02	---	7.46E+00	RME EPC is max detect	4 of 4
Vanadium	1.23E-02	1.50E-02	9.30E-03	1.08E+00	---	1.50E-02	RME EPC is max detect	4 of 4

Notes:
* Chemicals of interest are any chemical measured in at least one sample.
(1) - TRRP 24. TCEQ, March 31, 2006.
(2) RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 6
EXPOSURE POINT CONCENTRATIONS (mg/kg)
INTRACOASTAL WATERWAY SEDIMENT

Chemical of Interest[+]	Average	Max Detection	Min Detection	$^{Tot}Sed_{Comb}$ [(1)]		95% UCL	Statistic Used [(2)]	# of Detects/# of Samples
1,2-Dichloroethane	3.02E-03	3.02E-03	3.02E-03	6.0E+02	<	3.58E-04	median	1 of 16
1,2-Diphenylhydrazine/azobenzene	3.17E-02	3.17E-02	3.17E-02	1.3E+02	<	1.10E-02	median	1 of 16
2-Methylnaphthalene	1.88E-02	1.88E-02	1.88E-02	4.9E+02	<	1.46E-02	median	1 of 16
3,3'-Dichlorobenzidine	1.51E-01	1.51E-01	1.51E-01	3.2E+01	<	6.32E-02	median	1 of 16
4,4'-DDT	6.90E-04	3.32E-03	4.81E-04	8.7E+01	<	2.03E-04	median	4 of 17
4,6-Dinitro-2-methylphenol	6.27E-02	6.27E-02	6.27E-02	3.1E+02	<	2.64E-02	median	1 of 16
Acenaphthene	2.64E-02	6.31E-02	2.39E-02	7.4E+03	<	1.35E-02	median	2 of 16
Aluminum	6.85E+03	1.25E+04	3.90E+03	1.5E+05		7.88E+03	95% Student's-t	16 of 16
Anthracene	3.00E-02	7.53E-02	2.36E-02	3.7E+04	<	1.78E-02	median	6 of 16
Antimony	2.25E+00	8.14E+00	7.40E-01	8.3E+01		4.98E+00	97.5% Chebyshev	16 of 16
Arsenic	4.03E+00	7.62E+00	2.41E+00	1.1E+02		4.64E+00	95% Student's-t	16 of 16
Atrazine (Aatrex)	8.14E-02	8.14E-02	8.14E-02	6.4E+01	<	2.59E-02	median	1 of 16
Barium	2.15E+02	3.77E+02	1.16E+02	2.3E+04		3.08E+02	97.5% Chebyshev	16 of 16
Benzo(a)anthracene	9.54E-02	3.95E-01	6.75E-02	1.6E+01	<	1.38E-02	99% Chebyshev	3 of 16
Benzo(a)pyrene	**9.46E-02**	**4.45E-01**	**5.25E-02**	**1.6E+00**	**<**	**1.58E-02**	**median**	**6 of 16**
Benzo(b)fluoranthene	1.12E-01	6.11E-01	3.24E-02	1.6E+01		3.52E-01	97.5% KM (Chebyshev)	9 of 16
Benzo(g,h,i)perylene	7.19E-02	4.42E-01	1.73E-02	3.7E+03	<	1.72E-02	median	7 of 16
Benzo(k)fluoranthene	8.18E-02	3.18E-01	4.74E-02	1.6E+02	<	2.43E-01	median	6 of 16
Beryllium	4.63E-01	8.20E-01	2.90E-01	2.7E+01		5.28E-01	95% Student's-t	16 of 16
Boron	1.65E+01	2.72E+01	1.25E+01	1.1E+05		2.47E+01	97.5% KM (Chebyshev)	10 of 16
Butyl Benzyl Phthalate	2.02E-01	2.02E-01	2.02E-01	3.1E+04	<	1.65E-02	median	1 of 16
Carbazole	2.53E-02	8.61E-02	1.95E-02	7.1E+02	<	1.38E-02	median	3 of 16
Chloroform	5.05E-03	5.27E-03	5.04E-03	7.3E+03	<	4.42E-04	median	2 of 16
Chromium	9.21E+00	1.44E+01	5.01E+00	3.6E+04		1.04E+01	95% Student's-t	16 of 16
Chrysene	8.03E-02	4.75E-01	1.37E-02	1.6E+03		2.73E-01	97.5% KM (Chebyshev)	10 of 16
Cobalt	4.39E+00	7.16E+00	3.05E+00	3.2E+04		4.88E+00	95% Student's-t	16 of 16
Copper	7.11E+00	1.26E+01	3.28E+00	2.1E+04		8.43E+00	95% Student's-t	16 of 16
Cyclohexane	1.92E-03	1.92E-03	1.92E-03	1.0E+06	<	3.29E-03	median	1 of 16
Dibenz(a,h)anthracene	**7.12E-02**	**2.35E-01**	**5.11E-02**	**1.6E+00**	**<**	**1.57E-02**	**median**	**6 of 16**
Dibenzofuran	2.70E-02	3.05E-02	2.68E-02	6.1E+02	<	1.92E-02	median	2 of 16
Diethyl Phthalate	3.89E-02	3.89E-02	3.89E-02	1.2E+05	<	2.24E-02	median	1 of 16
Di-n-octyl Phthalate	2.58E-02	1.92E-01	1.47E-02	3.1E+03	<	1.13E-02	median	2 of 16
Fluoranthene	1.20E-01	8.04E-01	2.22E-02	4.9E+03		4.39E-01	97.5% KM (Chebyshev)	8 of 16
Fluorene	1.62E-02	4.60E-02	1.24E-02	4.9E+03	<	1.38E-02	median	4 of 16
gamma-Chlordane	6.54E-04	8.26E-04	6.38E-04	4.1E+01	<	3.91E-04	median	4 of 16
Hexachlorobenzene	3.19E-02	3.19E-02	3.19E-02	8.9E+00	<	1.62E-02	median	1 of 16
Indeno(1,2,3-cd)pyrene	9.99E-02	4.05E-01	5.56E-02	1.6E+01	<	2.53E-02	median	6 of 16
Iron	1.34E+04	2.82E+04	6.75E+03	---		2.20E+04	97.5% Chebyshev	16 of 16
Isopropylbenzene (cumene)	4.79E-03	7.04E-03	4.64E-03	7.3E+04	<	4.80E-04	median	2 of 16
Lead	1.16E+01	3.23E+01	5.00E+00	5.0E+02		2.27E+01	97.5% Chebyshev	16 of 16
Lithium	1.05E+01	2.00E+01	6.40E+00	1.1E+04		1.21E+01	95% Student's-t	16 of 16
Manganese	2.83E+02	4.74E+02	1.92E+02	1.4E+04		3.22E+02	95% Student's-t	16 of 16
Mercury	2.01E-02	3.60E-02	1.10E-02	3.4E+01		2.33E-02	95% Student's-t	16 of 16
Methylcyclohexane	3.70E-03	3.70E-03	3.70E-03	1.0E+06	<	1.70E-03	median	1 of 16
Molybdenum	6.67E-01	5.66E+00	1.40E-01	1.8E+03		2.15E+00	95% Chebyshev	16 of 16
Nickel	9.59E+00	1.67E+01	5.80E+00	1.4E+03		1.08E+01	95% Student's-t	16 of 16
n-Nitrosodiphenylamine	4.34E-02	4.34E-02	4.34E-02	9.0E+02	<	1.50E-02	median	1 of 16
Phenanthrene	8.58E-02	5.08E-01	3.11E-02	3.7E+03		2.80E-01	97.5% KM (Chebyshev)	8 of 16
Pyrene	1.33E-01	8.62E-01	1.76E-02	3.7E+03		4.82E-01	97.5% KM (Chebyshev)	10 of 16
Silver	3.35E-01	5.40E-01	3.00E-01	3.5E+02	<	8.95E-02	median	6 of 16
Strontium	4.49E+01	8.17E+01	3.28E+01	1.5E+05		5.12E+01	95% Student's-t	16 of 16
Titanium	2.56E+01	3.66E+01	1.91E+01	1.0E+06		2.78E+01	95% Student's-t	16 of 16
Toluene	5.81E-03	5.81E-03	5.81E-03	5.9E+04	<	1.73E-03	median	1 of 16
Vanadium	1.39E+01	2.12E+01	9.06E+00	3.3E+02		1.54E+01	95% Student's-t	16 of 16
Zinc	4.54E+01	9.26E+01	1.80E+01	7.6E+04		5.41E+01	95% Student's-t	16 of 16

Notes:

[+] Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

(1) - From Tier 1 Sediment PCLs. TCEQ, March 31, 2006.

(2) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 7
EXPOSURE POINT CONCENTATION (mg/kg)
INTRACOASTAL WATERWAY BACKGROUND SEDIMENT

Chemical of Interest[+]	Average	Max Detection	Min Detection	$^{Tot}Sed_{Comb}$ [(1)]		95% UCL	Statistic Used [(2)]	# of Detects/# of Samples
1,2,4-Trimethylbenzene	3.91E-03	3.91E-03	3.91E-03	3.7E+04	<	7.24E-04	median	1 of 9
1,4-Dichlorobenzene	4.11E-03	4.11E-03	4.11E-03	2.3E+03	<	1.54E-03	median	1 of 9
2-Butanone	2.08E-03	2.16E-03	2.00E-03	4.4E+05	<	2.00E-03	median	2 of 9
4,4'-DDT	5.70E-04	5.70E-04	5.70E-04	8.7E+01	<	2.10E-04	median	1 of 9
Aluminum	**1.22E+04**	**2.18E+04**	**4.73E+03**	**1.5E+05**		**1.65E+04**	**95% Student's-t**	**9 of 9**
Antimony	4.02E+00	7.33E+00	1.68E+00	8.3E+01		5.40E+00	95% Student's-t	9 of 9
Arsenic	5.81E+00	9.62E+00	2.36E+00	1.1E+02		7.74E+00	95% Student's-t	9 of 9
Barium	209.7.2	2.80E+02	1.11E+02	2.3E+04		2.39E+02	95% Student's-t	9 of 9
Benzo(b)fluoranthene	3.69E-02	3.69E-02	3.69E-02	1.6E+01	<	1.09E-02	median	1 of 9
Beryllium	7.66E-01	1.32E+00	3.20E-01	2.7E+01		1.02E+00	95% Student's-t	9 of 9
Boron	2.76E+01	4.79E+01	1.33E+01	1.1E+05		3.56E+01	95% Student's-t	9 of 9
Carbon Disulfide	5.91E-03	8.41E-03	3.41E-03	7.3E+04	<	8.40E-04	median	2 of 9
Chromium	1.28E+01	2.25E+01	5.81E+00	3.6E+04		1.69E+01	95% Student's-t	9 of 9
cis-1,2-Dichloroethene	2.84E-02	2.84E-02	2.84E-02	7.3E+03	<	4.61E-04	median	1 of 9
Cobalt	6.70E+00	1.18E+01	3.32E+00	3.2E+04		8.66E+00	95% Student's-t	9 of 9
Copper	8.14E+00	1.68E+01	2.68E+00	2.1E+04		1.13E+01	95% Student's-t	9 of 9
Iron	1.65E+04	2.79E+04	7.44E+03	---		2.15E+04	95% Student's-t	9 of 9
Lead	9.59E+00	1.45E+01	5.34E+00	5.0E+02		1.18E+01	95% Student's-t	9 of 9
Lithium	2.14E+01	4.46E+01	7.29E+00	1.1E+04		3.03E+01	95% Student's-t	9 of 9
Manganese	3.31E+02	4.42E+02	2.12E+02	1.4E+04		3.86E+02	95% Student's-t	9 of 9
Mercury	1.76E-02	5.00E-02	6.50E-03	3.4E+01		3.68E-02	95% Chebyshev	9 of 9
Molybdenum	2.41E-01	3.50E-01	1.60E-01	1.8E+03		2.83E-01	95% Student's-t	9 of 9
Nickel	1.49E+01	2.73E+01	6.31E+00	1.4E+03		1.99E+01	95% Student's-t	9 of 9
Strontium	5.92E+01	8.74E+01	3.48E+01	1.5E+05		7.28E+01	95% Student's-t	9 of 9
Titanium	3.18E+01	5.45E+01	2.11E+01	1.0E+06		3.83E+01	95% Student's-t	9 of 9
Trichloroethene	1.59E-02	1.59E-02	1.59E-02	4.4E+03	<	6.47E-04	median	1 of 9
Vanadium	**2.02E+01**	**3.42E+01**	**1.02E+01**	**3.3E+02**		**2.59E+01**	**95% Student's-t**	**9 of 9**
Xylene	3.35E-03	3.35E-03	3.35E-03	1.5E+05	<	2.09E-03	median	1 of 9
Zinc	3.60E+01	5.41E+01	1.93E+01	7.6E+04		4.45E+01	95% Student's-t	9 of 9

Notes:

[+] Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

[(1)] - From Tier 1 Sediment PCLs. TCEQ, March 31, 2006.

[(2)] - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A). When the compound was not detected in a given sample, one-half of the sample detection limit was used as the proxy concentration for that sample.

TABLE 8
EXPOSURE POINT CONCENTRATIONS (mg/kg)
NORTH AREA SURFACE SOIL*

Chemical of Interest*	Average	Max Detection	Min Detection	$^{Tot}Soil_{Comb}$ (1)	EPA Region 6 Soil Screening Criteria (2)		95% UCL	Statistic Used (3)	# of Detects/# of Samples
2-Methylnaphthalene	1.46E-02	5.30E-02	1.00E-02	2.48E+03	---	<	1.18E-02	median	3 of 18
4,4'-DDE	2.87E-03	1.49E-02	2.16E-03	7.32E+01	7.80E+00	<	4.24E-04	median	2 of 18
4,4'-DDT	1.50E-03	1.08E-02	5.97E-04	6.84E+01	7.80E+00	<	5.45E-04	median	7 of 18
Acenaphthene	2.86E-02	1.57E-01	2.10E-02	3.72E+04	3.30E+04	<	1.10E-02	median	2 of 18
Acenaphthylene	5.55E-02	5.55E-02	5.55E-02	3.72E+04	---	<	1.21E-02	median	1 of 18
Aluminum	**1.07E+04**	**1.68E+04**	**1.81E+03**	**5.70E+05**	**1.00E+05**		**1.22E+04**	**95% Student's-t**	**18 of 18**
Anthracene	2.69E-02	2.64E-01	8.87E-03	1.86E+05	1.00E+05	<	1.21E-02	median	4 of 18
Antimony	2.52E+00	8.09E+00	1.66E+00	3.06E+02	4.50E+02		4.95E+00	97.5% KM (Chebyshev)	9 of 18
Aroclor-1254	1.22E-02	1.22E-02	1.22E-02	7.10E+00	8.30E-01	<	4.29E-03	median	1 of 18
Arsenic	**2.53E+00**	**5.69E+00**	**5.40E-01**	**1.96E+02**	**1.80E+00**		**4.22E+00**	**97.5% KM (Chebyshev)**	**17 of 18**
Barium	1.45E+02	4.76E+02	4.61E+01	8.90E+04	7.90E+04		2.64E+02	95% Chebyshev	18 of 18
Benzo(a)anthracene	**1.18E+00**	**1.18E+00**	**1.18E+00**	**2.36E+01**	**2.30E+00**	**<**	**1.10E-02**	**median**	**1 of 18**
Benzo(a)pyrene	**1.19E-01**	**1.42E+00**	**1.35E-02**	**2.37E+00**	**2.30E-01**	**<**	**1.16E-02**	**median**	**7 of 18**
Benzo(b)fluoranthene	**1.69E-01**	**1.62E+00**	**4.87E-02**	**2.36E+01**	**2.30E+00**		**3.73E-01**	**95% KM (BCA)**	**8 of 18**
Benzo(g,h,i)perylene	1.40E-01	1.28E+00	2.37E-02	1.86E+04	---		5.92E-01	97.5% KM (Chebyshev)	10 of 18
Benzo(k)fluoranthene	1.13E-01	7.99E-01	1.10E-02	2.37E+02	2.30E+01	<	1.75E-02	median	4 of 18
Beryllium	7.11E-01	2.88E+00	6.60E-02	2.47E+02	2.20E+03		1.60E+00	97.5% KM (Chebyshev)	17 of 18
Bis(2-ethylhexyl)phthalate	4.45E-02	2.39E-01	1.22E-02	5.63E+02	1.40E+02	<	5.46E-02	median	6 of 18
Boron	8.74E+00	3.92E+01	3.15E+00	1.92E+05	1.00E+05		2.21E+01	97.5% KM (Chebyshev)	13 of 18
Butyl Benzyl Phthalate	1.51E-01	1.51E-01	1.51E-01	1.00E+04	2.40E+02	<	1.36E-02	median	1 of 18
Cadmium	3.58E-01	8.00E-01	2.80E-01	8.52E+02	5.60E+02		5.72E-01	97.5% KM (Chebyshev)	8 of 18
Carbazole	2.00E-02	1.28E-01	1.30E-02	9.54E+02	9.60E+01	<	1.11E-02	median	4 of 18
Chromium	**2.03E+01**	**1.28E+02**	**7.90E+00**	**5.71E+04**	**5.00E+02**		**4.86E+01**	**95% Chebyshev**	**18 of 18**
Chrysene	1.05E-01	1.30E+00	1.10E-02	2.36E+03	2.30E+02	<	1.03E-02	median	7 of 18
Cobalt	5.79E+00	7.87E+00	2.81E+00	2.70E+02	2.10E+03		6.41E+00	95% Student's-t	18 of 18
Copper	2.41E+01	2.00E+02	5.90E+00	3.69E+04	4.20E+04		7.00E+01	95% Chebyshev	18 of 18
Dibenz(a,h)anthracene	**7.69E-02**	**4.04E-01**	**4.50E-02**	**2.37E+00**	**2.30E-01**	**<**	**1.10E-02**	**median**	**4 of 18**
Dibenzofuran	8.62E-02	8.62E-02	8.62E-02	2.73E+03	1.70E+03	<	1.52E-02	median	1 of 18
Dieldrin	5.45E-03	5.45E-03	5.45E-03	1.14E+00	1.20E-01	<	1.83E-04	median	1 of 18
Diethyl Phthalate	1.10E-02	1.10E-02	1.10E-02	2.04E+03	1.00E+05	<	1.85E-02	median	1 of 18
Di-n-butyl Phthalate	1.00E-02	1.00E-02	1.00E-02	1.62E+04	6.80E+04	<	3.10E-02	median	1 of 18
Di-n-octyl Phthalate	2.14E-02	1.23E-01	1.54E-02	1.30E+04	2.70E+04	<	9.50E-03	median	2 of 18
Endrin	1.49E-03	1.49E-03	1.49E-03	1.27E+02	2.10E+02	<	2.22E-04	median	1 of 18
Endrin Ketone	9.66E-03	9.66E-03	9.66E-03	1.77E+02	---	<	5.48E-04	median	1 of 18
Fluoranthene	1.68E-01	2.19E+00	2.14E-02	2.48E+04	2.40E+04	<	1.28E-02	median	6 of 18
Fluorene	2.50E-02	1.41E-01	1.70E-02	2.48E+04	2.60E+04	<	1.09E-02	median	3 of 18
Indeno(1,2,3-cd)pyrene	**1.55E-01**	**1.51E+00**	**2.00E-02**	**2.37E+01**	**2.30E+00**		**6.82E-01**	**97.5% KM (Chebyshev)**	**9 of 18**
Iron	**1.95E+04**	**1.02E+05**	**8.45E+03**	**---**	**1.00E+05**		**4.11E+04**	**95% Chebyshev**	**18 of 18**
Lead	**5.77E+01**	**4.71E+02**	**8.22E+00**	**1.60E+03**	**8.00E+02**		**3.18E+02**	**99% Chebyshev**	**18 of 18**
Lithium	1.66E+01	2.66E+01	2.59E+00	1.90E+03	2.30E+04		1.87E+01	95% Student's-t	18 of 18
Manganese	3.70E+02	1.21E+03	8.23E+01	2.41E+04	3.50E+04		7.34E+02	97.5% KM (Chebyshev)	18 of 18
Mercury	1.38E-02	6.40E-02	6.00E-03	3.26E+00	3.40E+02		3.75E-02	97.5% KM (Chebyshev)	8 of 18
Molybdenum	9.66E-01	1.07E+01	8.50E-02	4.51E+03	5.70E+03		4.71E+00	97.5% KM (Chebyshev)	11 of 18
Nickel	1.70E+01	5.17E+01	1.17E+01	7.94E+03	2.30E+04		2.08E+01	95% Student's-t	18 of 18
Phenanthrene	1.15E-01	1.34E+00	1.80E-02	1.86E+04	---	<	1.42E-02	median	7 of 18
Pyrene	3.86E-01	1.87E+00	1.49E-02	1.86E+04	3.20E+04		2.03E+00	97.5% KM (Chebyshev)	8 of 18
Silver	1.10E-01	4.10E-01	9.20E-02	1.71E+03	5.70E+03	<	6.00E-02	median	2 of 18
Strontium	5.73E+01	9.36E+01	2.66E+01	4.91E+05	1.00E+05		6.54E+01	95% Student's-t	18 of 18
Thallium	6.30E-01	6.30E-01	6.30E-01	7.80E+01	---	<	1.00E-01	median	1 of 18
Tin	7.06E-01	3.67E+00	6.80E-01	3.97E+05	---	<	5.90E-01	median	4 of 18
Titanium	2.07E+01	5.59E+01	3.41E+00	1.00E+06	---		3.78E+01	97.5% KM (Chebyshev)	18 of 18
Vanadium	1.97E+01	4.58E+01	7.85E+00	2.29E+03	1.10E+03		2.34E+01	95% Student's-t	18 of 18
Zinc	4.18E+02	5.64E+03	2.95E+01	2.45E+05	1.00E+05		3.49E+03	99% Chebyshev	18 of 18

Notes:

* Surface soil was collected from 0 to 0.5 ft. below ground surface.

+ Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

(1) - $^{Tot}Soil_{Comb}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Commercial/Industrial total soil combined pathway (includes inhalation; ingestion; dermal pathways).

(2) - From EPA's "Region 6 Human Health Medium-Specific Screening Levels 2004-2005". Industrial Outdoor Worker.

(3) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 9
EXPOSURE POINT CONCENTRATIONS (mg/kg)
NORTH AREA SOIL+

Chemical of Interest++	Average	Max Detection	Min Detection	$^{Tot}Soil_{Comb}$ (1)	EPA Region 6 Soil Screening Criteria(2)		95% UCL	Statistic Used (3)	# of Detects/# of Samples
1,1-Dichloroethane	2.67E-02	5.18E-01	1.61E-03	4.30E+03	2.30E+03	<	1.75E-04	median	3 of 19
1,1-Dichloroethene	1.73E-02	3.13E-01	1.78E-03	3.50E+03	4.70E+02	<	3.95E-04	median	2 of 19
1,2-Dichloroethane	**1.95E-02**	**1.77E-01**	**2.31E-03**	**1.15E+01**	**8.40E-01**	**<**	**1.27E-04**	**median**	**4 of 19**
2-Butanone	1.32E-02	2.08E-01	1.70E-03	7.26E+04	3.40E+04		7.87E-02	97.5% KM (Chebyshev)	11 of 19
2-Methylnaphthalene	4.05E-02	5.30E-02	1.00E-02	2.48E+03	---	<	1.19E-02	median	4 of 38
4,4'-DDE	2.50E-03	1.49E-02	2.16E-03	7.32E+01	7.80E+00	<	4.28E-04	median	2 of 38
4,4'-DDT	1.16E-02	1.08E-02	5.97E-04	6.84E+01	7.80E+00	<	7.94E-02	97.5% KM (Chebyshev)	7 of 38
Acenaphthene	1.99E-02	1.57E-01	2.10E-02	3.72E+04	3.30E+04	<	1.11E-02	median	4 of 38
Aluminum	**1.23E+04**	**1.83E+04**	**1.81E+03**	**5.70E+05**	**1.00E+05**		**1.33E+04**	**95% Student's-t**	**38 of 38**
Anthracene	2.90E-02	2.64E-01	8.87E-03	1.86E+05	1.00E+05		8.96E-02	97.5% KM (Chebyshev)	6 of 38
Antimony	1.45E+00	8.09E+00	1.66E+00	3.06E+02	4.50E+02		2.45E+00	95% KM (Bootstrap)	16 of 38
Aroclor-1254	**1.81E-01**	**9.38E-02**	**1.22E-02**	**7.10E+00**	**8.30E-01**	**<**	**4.30E-03**	**median**	**2 of 38**
Arsenic	**2.44E+00**	**5.69E+00**	**5.40E-01**	**1.96E+02**	**1.80E+00**		**3.82E+00**	**97.5% KM (Chebyshev)**	**32 of 38**
Barium	1.41E+02	3.62E+02	4.61E+01	8.90E+04	7.90E+04		2.34E+02	97.5% Chebyshev	38 of 38
Benzene	2.92E-03	6.32E-03	1.38E-03	1.11E+02	1.60E+00		5.39E-03	97.5% KM (Chebyshev)	12 of 18
Benzo(a)anthracene	**1.09E-01**	**1.18E+00**	**3.83E-02**	**2.36E+01**	**2.30E+00**	**<**	**1.11E-02**	**median**	**4 of 38**
Benzo(a)pyrene	**9.37E-02**	**1.42E+00**	**1.35E-02**	**2.37E+00**	**2.30E-01**		**3.78E-01**	**97.5% KM (Chebyshev)**	**10 of 38**
Benzo(b)fluoranthene	**1.44E-01**	**1.62E+00**	**4.87E-02**	**2.36E+01**	**2.30E+00**		**2.52E-01**	**95% KM (Bootstrap)**	**11 of 38**
Benzo(g,h,i)perylene	1.03E-01	1.28E+00	2.37E-02	1.86E+04	---		3.42E-01	97.5% KM (Chebyshev)	14 of 38
Benzo(k)fluoranthene	1.07E-01	7.99E-01	6.80E-02	2.37E+02	2.30E+01	<	1.72E-02	median	6 of 38
Beryllium	7.15E-01	2.88E+00	6.60E-02	2.47E+02	2.20E+03		1.18E+00	97.5% KM (Chebyshev)	35 of 38
Bis(2-ethylhexyl)phthalate	4.12E-02	2.39E-01	1.22E-02	5.63E+02	1.40E+02		9.96E-02	97.5% KM (Chebyshev)	11 of 38
Boron	7.64E+00	3.92E+01	3.14E+00	1.92E+05	1.00E+05		1.71E+01	97.5% KM (Chebyshev)	26 of 38
Bromoform	1.14E-02	1.80E-02	1.10E-02	6.04E+02	2.40E+02	<	1.86E-04	median	2 of 19
Butyl Benzyl Phthalate	5.66E-02	1.51E-01	5.40E-02	1.00E+04	2.40E+02	<	1.36E-02	median	2 of 38
Cadmium	3.63E-01	8.00E-01	2.80E-01	8.52E+02	5.60E+02		5.19E-01	97.5% KM (Chebyshev)	15 of 38
Carbazole	1.74E-02	1.28E-01	1.08E-02	9.54E+02	9.60E+01	<	1.10E-02	median	7 of 38
Carbon Disulfide	8.64E-03	2.84E-02	7.57E-03	7.19E+03	7.20E+02	<	1.19E-04	median	3 of 19
Chromium	**1.83E+01**	**1.28E+02**	**7.76E+00**	**5.70E+04**	**5.00E+02**		**3.21E+01**	**95% Chebyshev**	**38 of 38**
Chrysene	1.03E-01	1.30E+00	1.04E-02	2.40E+03	2.30E+02		3.84E-01	97.5% KM (Chebyshev)	11 of 38
cis-1,2-Dichloroethene	6.61E-02	9.99E-01	1.95E-02	4.70E+03	1.60E+02	<	1.38E-04	median	2 of 19
Cobalt	6.52E+00	1.03E+01	2.81E+00	2.70E+02	2.10E+03		7.04E+00	95% Student's-t	38 of 38
Copper	6.56E+01	2.00E+02	4.59E+00	3.70E+04	4.20E+04		5.12E+02	99% Chebyshev	38 of 38
Cyclohexane	1.13E-03	1.85E-03	9.81E-04	4.20E+04	6.80E+03	<	1.25E-03	median	5 of 19
Dibenz(a,h)anthracene	**6.88E-02**	**4.04E-01**	**4.50E-02**	**2.40E+00**	**2.30E-01**	**<**	**1.08E-02**	**median**	**7 of 38**
Dibenzofuran	1.96E-02	8.62E-02	1.50E-02	2.70E+03	1.70E+04	<	1.50E-02	median	2 of 38
Diethyl Phthalate	1.01E-02	1.10E-02	9.92E-03	2.04E+03	1.00E+05	<	1.85E-02	median	2 of 38
Di-n-butyl Phthalate	1.05E-02	1.50E-02	1.00E-02	1.62E+04	6.80E+04	<	3.07E-02	median	2 of 38
Di-n-octyl Phthalate	1.90E-02	1.23E-01	1.54E-02	1.30E+04	2.70E+04	<	9.52E-03	median	3 of 38
Ethylbenzene	2.69E-03	5.02E-03	1.14E-03	1.00E+04	2.30E+02	<	1.14E-03	median	5 of 19
Fluoranthene	1.44E-01	2.19E+00	2.14E-02	2.48E+04	2.40E+04	<	6.24E-01	97.5% KM (Chebyshev)	9 of 38
Fluorene	5.27E-02	1.41E-01	1.70E-02	2.48E+04	2.60E+04	<	3.92E-04	median	4 of 38
Indeno(1,2,3-cd)pyrene	**1.15E-01**	**1.51E+00**	**2.00E-02**	**2.37E+01**	**2.30E+00**		**3.96E-01**	**97.5% KM (Chebyshev)**	**13 of 38**
Iron	**2.09E+04**	**1.02E+05**	**7.12E+03**	**---**	**1.00E+05**		**3.69E+04**	**95% Chebyshev**	**38 of 38**
Lead	**5.30E+01**	**5.83E+00**	**6.30E+02**	**1.60E+03**	**8.00E+02**		**2.48E+02**	**99% Chebyshev**	**34 of 38**
Lithium	1.92E+01	3.22E+01	2.59E+00	1.90E+03	2.30E+04		2.08E+01	95% Student's-t	36 of 38
m,p-xylene	1.32E-03	1.39E-03	1.32E-03	6.50E+03	2.10E+02	<	4.22E-04	median	2 of 19
Manganese	3.87E+02	1.21E+03	8.23E+01	2.41E+04	3.50E+04		6.39E+02	97.5% Chebyshev	38 of 38
Mercury	1.43E-02	1.70E-01	3.40E-03	3.26E+00	3.40E+02		4.38E-02	97.5% KM (Chebyshev)	15 of 38
Methylcyclohexane	1.76E-03	2.78E-03	1.50E-03	3.29E+04	1.40E+02	<	1.54E-03	median	6 of 19
Molybdenum	1.40E-01	1.07E+01	8.50E-02	4.51E+03	5.70E+03		2.49E+00	97.5% KM (Chebyshev)	21 of 38
Naphthalene	3.24E+00	1.48E-01	1.30E-03	1.90E+02	2.10E+02	<	3.70E-03	median	6 of 19
Nickel	1.80E+01	5.17E+01	9.74E+00	7.94E+03	2.30E+04		2.01E+01	95% Student's-t	38 of 38
Phenanthrene	1.50E-01	1.83E+00	1.80E-02	1.86E+04	---		5.70E-01	97.5% KM (Chebyshev)	12 of 38
Pyrene	2.62E-01	4.64E+00	1.49E-02	1.86E+04	3.20E+04		1.12E+00	97.5% KM (Chebyshev)	14 of 38
Silver	1.05E-01	4.10E-01	9.20E-02	1.71E+03	5.70E+03	<	5.90E-02	median	3 of 38
Strontium	5.64E+01	9.62E+01	2.21E+01	4.91E+05	1.00E+05		6.20E+01	95% Student's-t	38 of 38
Tetrachloroethene	**1.26E-02**	**2.23E-01**	**1.35E-03**	**3.30E+02**	**1.70E+00**	**<**	**2.11E-04**	**median**	**3 of 19**
Tin	5.34E+00	3.67E+00	6.80E-01	3.97E+05	---	<	5.70E-01	median	5 of 38
Titanium	2.33E+01	5.70E+01	3.41E+00	1.00E+06	---		4.03E+01	97.5% Chebyshev	38 of 38
Toluene	3.24E-03	1.22E-02	1.34E-03	2.90E+04	5.20E+02		8.15E-03	97.5% KM (Chebyshev)	8 of 19
Vanadium	2.10E+01	4.58E+01	7.85E+00	2.29E+03	1.10E+03		2.33E+01	95% Student's-t	38 of 38
Xylene (total)	1.78E-01	1.76E+00	1.39E-03	6.50E+03	2.10E+02		8.58E-01	97.5% KM (Chebyshev)	8 of 19
Zinc	2.83E+02	5.64E+03	2.11E+01	2.45E+05	1.00E+05		1.78E+03	99% Chebyshev	38 of 38

Notes:
+ Soil was collected from 0 to 4 ft. below ground surface.
++ Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.
(1) - $^{Tot}Soil_{Comb}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Commercial/Industrial total soil combined pathway (includes inhalation; ingestion; dermal pathways).
(2) - From EPA's "Region 6 Human Health Medium-Specific Screening Levels 2004-2005", Industrial Outdoor Worker.
(3) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 10
EXPOSURE POINT CONCENTATIONS (mg/L)
NORTH AREA ZONE A GROUNDWATER

Chemical of Interest[+]	Average		RME EPC [(1)]	Notes:	# of Detects/# of Samples
1,1,1-Trichloroethane	1.48E+01		1.56E+02	RME EPC is max detect	5 of 16
1,1-Dichloroethane	2.80E+00		3.15E+01	RME EPC is max detect	5 of 12
1,1-Dichloroethene	3.46E+00		2.92E+01	RME EPC is max detect	6 of 16
1,2,3-Trichloropropane	6.17E+00		4.43E+01	RME EPC is max detect	5 of 16
1,2,4-Trimethylbenzene	3.80E-02		4.20E-02	RME EPC is max detect	1 of 12
1,2-Dichloroethane	2.42E+01		3.28E+02	RME EPC is max detect	6 of 16
1,2-Dichloropropane	4.90E-01		3.45E+00	RME EPC is max detect	4 of 16
2-Methylnaphthalene	2.70E-03		1.60E-02	RME EPC is max detect	2 of 12
4,4'-DDD	2.48E-06		1.90E-05	RME EPC is max detect	1 of 12
4,4'-DDE	2.14E-05		2.70E-04	RME EPC is max detect	2 of 12
4-Chloroaniline	1.50E-03		1.30E-02	RME EPC is max detect	1 of 12
4-Isopropyltoluene	2.30E-02		2.00E-03	RME EPC is max detect*	1 of 12
Acenaphthene	9.00E-04		8.60E-03	RME EPC is max detect	1 of 12
Acetone	2.81E-01		1.15E-01	RME EPC is max detect*	1 of 12
Acetophenone	6.80E-03		7.40E-02	RME EPC is max detect	1 of 12
alpha-BHC	1.96E-05		2.00E-04	RME EPC is max detect	1 of 12
Aluminum	8.18E-02		2.60E-01	RME EPC is max detect	5 of 12
Aniline	1.30E-03		1.10E-02	RME EPC is max detect	1 of 12
Anthracene	4.30E-04		1.40E-03	RME EPC is max detect	2 of 12
Antimony	1.98E-02		4.30E-02	RME EPC is max detect	11 of 12
Arsenic	1.13E-02		2.80E-02	RME EPC is max detect	2 of 12
Barium	1.64E-01		1.38E+00	RME EPC is max detect	12 of 12
Benzene	1.02E+00		8.24E+00	RME EPC is max detect	7 of 16
Benzo(b)fluoranthene	3.23E-04		1.40E-03	RME EPC is max detect	1 of 12
Benzo(g,h,i)perylene	2.89E-04		1.50E-03	RME EPC is max detect	1 of 12
Benzoic Acid	1.10E-03		1.40E-03	RME EPC is max detect	5 of 12
beta-BHC	1.09E-05		8.30E-05	RME EPC is max detect	2 of 12
Bis(2-ethylhexyl)Phthalate	3.70E-03		6.00E-04	RME EPC is max detect	1 of 12
Boron	2.20E+00		3.44E+00	RME EPC is max detect	12 of 12
Carbazole	2.20E-03		7.70E-03	RME EPC is max detect	3 of 12
Carbon Tetrachloride	5.60E-01		7.58E+00	RME EPC is max detect	1 of 16
Chromium	9.10E-02		1.60E-01	RME EPC is max detect	12 of 12
cis-1,2-Dichloroethene	8.96E+00		1.24E+02	RME EPC is max detect	6 of 16
Cobalt	2.60E-03		1.60E-02	RME EPC is max detect	3 of 12
delta-BHC	5.97E-06		4.10E-05	RME EPC is max detect	2 of 12
Dibenz(a,h)anthracene	4.87E-04		2.90E-03	RME EPC is max detect	1 of 12
Dibenzofuran	6.01E-04		4.90E-03	RME EPC is max detect	1 of 12
Dieldrin	5.01E-06		2.64E-05	RME EPC is max detect	1 of 16
Endosulfan II	1.29E-05		1.20E-04	RME EPC is max detect	6 of 17
Endosulfan Sulfate	2.46E-06		1.56E-05	RME EPC is max detect	1 of 12
Endrin Aldehyde	1.31E-05		1.30E-04	RME EPC is max detect	1 of 12
Ethylbenzene	9.69E-02		7.40E-01	RME EPC is max detect	1 of 13
Fluorene	8.51E-04		6.10E-03	RME EPC is max detect	3 of 12
gamma-BHC (Lindane)	1.25E-04		1.50E-03	RME EPC is max detect	3 of 16
Heptachlor Epoxide	5.44E-06		2.50E-05	RME EPC is max detect	1 of 12
Indeno(1,2,3-cd)pyrene	4.73E-04		3.30E-03	RME EPC is max detect	1 of 12
Iron	1.31E+01		3.66E+01	RME EPC is max detect	12 of 12
Isopropylbenzene (Cumene)	2.80E-02		3.80E-02	RME EPC is max detect*	2 of 12
Lithium	3.19E-01		6.70E-01	RME EPC is max detect	12 of 12
m,p-Cresol	2.78E-03		1.20E-02	RME EPC is max detect	3 of 12
m,p-Xylene	6.85E-02		1.68E-01	RME EPC is max detect	1 of 12
Manganese	7.74E+00		2.69E+01	RME EPC is max detect	12 of 12
Methylene Chloride	9.57E+01		1.23E+03	RME EPC is max detect	4 of 16
Molybdenum	7.20E-03		5.50E-02	RME EPC is max detect	1 of 12
Naphthalene	7.83E-02		3.22E-01	RME EPC is max detect	1 of 13
Nickel	1.99E-02		1.40E-01	RME EPC is max detect	7 of 14
n-Propylbenzene	3.60E-02		3.10E-02	RME EPC is max detect*	1 of 12
o-Cresol	1.40E-03		8.10E-03	RME EPC is max detect	2 of 12
o-Xylene	4.62E-02		4.40E-02	RME EPC is max detect*	1 of 12
Phenanthrene	8.31E-04		6.40E-03	RME EPC is max detect	2 of 13
Pyrene	2.23E-04		5.00E-04	RME EPC is max detect	1 of 13
Silver	9.14E-03		1.70E-02	RME EPC is max detect	12 of 12
Strontium	1.10E+01		1.88E+01	RME EPC is max detect	12 of 12
Styrene	2.60E-02		2.50E-03	RME EPC is max detect*	1 of 12
Tetrachloroethene	1.95E+00		2.05E+01	RME EPC is max detect	4 of 16
Thallium	4.60E-03		3.00E-02	RME EPC is max detect	2 of 12
Titanium	1.20E-03		3.30E-03	RME EPC is max detect	3 of 12
Toluene	3.35E-01		4.05E+00	RME EPC is max detect	4 of 16
Trichloroethene	1.15E+01		8.40E+01	RME EPC is max detect	7 of 16
Vanadium	8.40E-03		2.40E-02	RME EPC is max detect	6 of 12
Vinyl Chloride	5.02E-01		5.09E+00	RME EPC is max detect	3 of 16
Xylene (total)	1.15E-01		2.12E-01	RME EPC is max detect	1 of 12

Notes:
*The maximum detected value is sometimes lower than the average since 1/2 of the reporting limit was used as a proxy value when it was not detected and because J flag data were used in the risk assessment.
[+] Chemicals of interest are any chemical measured in at least one sample.
[(1)] RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 11
EXPOSURE POINT CONCENTATIONS (mg/L)
WETLAND SURFACE WATER (TOTAL)

Chemical of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{comb}$ (1)	^{SW}RBELs Saltwater Fish Only (1)	RME EPC (2)	Statistic Used	# of Detects/# of Samples
1,2-Dichloroethane	2.30E-03	3.85E-03	2.55E-03	1.96E-01	4.93E-02	3.85E-03	RME EPC is max detect	3 of 4
Acrolein	1.21E-02	9.29E-03	9.29E-03	4.26E-01	2.90E-01	9.30E-03	RME EPC is max detect*	1 of 4
Aluminum	5.08E-01	8.00E-01	1.70E-01	4.03E+02	---	8.00E-01	RME EPC is max detect	4 of 4
Barium	2.20E-01	3.70E-01	1.50E-01	6.49E+01	---	3.70E-01	RME EPC is max detect	4 of 4
Boron	1.96E+00	2.42E+00	8.30E-01	7.44E+01	---	2.42E+00	RME EPC is max detect	4 of 4
Chromium	1.49E-02	3.70E-02	2.00E-02	1.26E+02	2.20E+00	3.70E-02	RME EPC is max detect	2 of 4
Chromium VI	3.13E-03	8.00E-03	8.00E-03	2.43E-01	---	8.00E-03	RME EPC is max detect	1 of 4
Copper	6.38E-03	1.10E-02	9.50E-03	3.31E+01	---	1.10E-02	RME EPC is max detect	2 of 4
Iron	6.45E-01	1.08E+00	1.90E-01	---	---	1.08E+00	RME EPC is max detect	4 of 4
Lithium	1.89E-01	2.50E-01	5.70E-02	1.65E+01	---	2.50E-01	RME EPC is max detect	4 of 4
Manganese	**1.37E-01**	**3.40E-01**	**1.80E-02**	**4.09E+01**	**1.00E-01**	**3.40E-01**	**RME EPC is max detect**	**4 of 4**
Mercury	**3.75E-05**	**7.00E-05**	**4.00E-05**	**9.73E-02**	**2.50E-05**	**7.00E-05**	**RME EPC is max detect**	**2 of 4**
Molybdenum	9.30E-03	1.50E-02	5.60E-03	3.47E+00	---	1.50E-02	RME EPC is max detect	3 of 4
Nickel	1.10E-03	2.20E-03	1.20E-03	1.13E+00	4.60E+00	2.20E-03	RME EPC is max detect	2 of 4
Strontium	5.27E+00	6.64E+00	1.87E+00	3.38E+02	---	6.64E+00	RME EPC is max detect	4 of 4
Titanium	6.40E-03	9.80E-03	2.40E-03	8.67E+04	---	9.80E-03	RME EPC is max detect	4 of 4
Zinc	7.30E-03	2.20E-02	2.20E-02	2.01E+02	2.60E+00	2.20E-02	RME EPC is max detect	1 of 4

WETLAND SURFACE WATER (DISSOLVED METALS)

Chemicals of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{comb}$ (1)	^{SW}RBELs Saltwater Fish Only (1)	RME EPC (2)	Statistic Used	# of Detects/# of Samples
Barium	3.20E-04	3.50E-01	1.40E-01	6.49E+01	---	3.50E-01	RME EPC is max detect	4 of 4
Boron	2.70E-02	2.75E+00	8.50E-01	7.44E+01	---	2.75E+00	RME EPC is max detect	4 of 4
Chromium	1.20E-03	3.70E-02	1.90E-02	1.26E+02	2.20E+00	3.70E-02	RME EPC is max detect	2 of 4
Copper	2.50E-03	1.10E-02	5.30E-03	3.31E+01	---	1.10E-02	RME EPC is max detect	3 of 4
Lithium	3.50E-03	2.80E-01	5.70E-02	1.65E+01	---	2.80E-01	RME EPC is max detect	4 of 4
Manganese	**6.00E-04**	**3.30E-01**	**2.50E-02**	**4.09E+01**	**1.00E-01**	**3.30E-01**	**RME EPC is max detect**	**4 of 4**
Molybdenum	2.70E-03	1.70E-02	5.40E-03	3.47E+00	---	1.70E-02	RME EPC is max detect	3 of 4
Nickel	4.50E-04	1.30E-03	4.90E-04	1.13E+00	4.60E+00	1.30E-03	RME EPC is max detect	2 of 4
Strontium	9.40E-04	7.01E+00	1.89E+00	3.38E+02	---	7.01E+00	RME EPC is max detect	4 of 4

Notes:
*The maximum detected value is sometimes lower than the average since 1/2 of the reporting limit was used as a proxy value when it was not detected, and because J flag data were used in the risk assessment.
+ Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.
(1) - TRRP 24. TCEQ, March 31, 2006.
(2) RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 12
EXPOSURE POINT CONCENTATIONS (mg/L)
POND SURFACE WATER (TOTAL)

Chemical of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{comb}$ (1)	^{SW}RBELs Saltwater Fish Only (1)	RME EPC (2)	Statistic Used	# of Detects/# of Samples
4-Chloroaniline	2.79E-04	8.23E-04	8.23E-04	2.14E+00	NA	8.00E-04	RME EPC is max detect	1 of 6
Aluminum	9.13E-01	2.22E+00	4.10E-01	4.03E+02	NA	2.22E+00	RME EPC is max detect	5 of 6
Antimony	3.82E-03	7.60E-03	3.00E-03	1.99E-01	6.40E+00	7.60E-03	RME EPC is max detect	3 of 6
Arsenic	**5.40E-03**	**1.30E-02**	**1.20E-02**	**2.85E-02**	**1.40E-02**	**1.30E-02**	**RME EPC is max detect**	**2 of 6**
Barium	1.45E-01	1.90E-01	1.30E-01	6.49E+01	NA	1.90E-01	RME EPC is max detect	6 of 6
Benzo(a)pyrene	1.12E-04	3.48E-04	3.48E-04	---	5.40E-03	3.00E-04	RME EPC is max detect	1 of 6
Benzo(b)fluoranthene	4.03E-04	1.81E-03	1.81E-03	---	1.80E-03	1.80E-03	RME EPC is max detect	1 of 6
Benzo(g,h,i)perylene	3.71E-04	1.73E-03	1.73E-03	---	NA	1.70E-03	RME EPC is max detect	1 of 6
Benzo(k)fluoranthene	2.06E-04	5.42E-04	5.42E-04	---	1.80E-03	5.00E-04	RME EPC is max detect	1 of 6
Bis(2-ethylhexyl)phthalate	1.92E-02	4.00E-02	2.90E-02	---	2.20E-01	4.00E-02	RME EPC is max detect	3 of 6
Boron	2.97E+00	3.52E+00	2.45E+00	7.44E+01	NA	3.52E+00	RME EPC is max detect	6 of 6
Chromium	8.50E-04	1.50E-03	1.50E-03	1.26E+02	2.20E+01	1.50E-03	RME EPC is max detect	1 of 6
Chromium VI	8.50E-03	1.60E-02	1.50E-02	2.43E-01	NA	1.60E-02	RME EPC is max detect	2 of 6
Chrysene	2.46E-04	7.10E-04	7.10E-04	---	5.40E-02	7.00E-04	RME EPC is max detect	1 of 6
Cobalt	9.12E-04	3.20E-03	5.20E-04	5.33E+01	NA	3.20E-03	RME EPC is max detect	2 of 6
Dibenz(a,h)anthracene	**6.26E-04**	**3.04E-03**	**3.04E-03**	**---**	**1.80E-03**	**3.00E-03**	**RME EPC is max detect**	**1 of 6**
Di-n-butyl Phthalate	3.12E-03	3.81E-03	1.07E-03	4.49E+00	4.50E+01	3.80E-03	RME EPC is max detect	5 of 6
Indeno(1,2,3-cd)pyrene	**6.73E-04**	**3.44E-03**	**3.44E-03**	**---**	**1.80E-03**	**3.40E-03**	**RME EPC is max detect**	**1 of 6**
Iron	2.27E+00	6.67E+00	5.20E-01	---	NA	6.67E+00	RME EPC is max detect	6 of 6
Lead	2.63E-03	1.10E-02	1.10E-02	---	1.69E-01	1.10E-02	RME EPC is max detect	1 of 6
Lithium	1.16E-01	1.60E-01	6.70E-02	1.65E+01	NA	1.60E-01	RME EPC is max detect	6 of 6
Manganese	6.37E-01	1.44E+00	8.50E-02	4.09E+01	1.00E+00	1.44E+00	RME EPC is max detect	6 of 6
Molybdenum	8.73E-03	1.80E-02	1.30E-02	3.47E+00	NA	1.80E-02	RME EPC is max detect	3 of 6
Nickel	4.60E-03	7.90E-03	3.00E-03	1.13E+01	4.60E+01	7.90E-03	RME EPC is max detect	6 of 6
Selenium	4.26E-03	9.80E-03	9.80E-03	4.13E+00	4.20E+01	9.80E-03	RME EPC is max detect	1 of 6
Silver	9.30E-03	1.50E-02	3.70E-03	1.57E+00	NA	1.50E-02	RME EPC is max detect	6 of 6
Strontium	4.47E+00	7.19E+00	1.77E+00	3.38E+02	NA	7.19E+00	RME EPC is max detect	6 of 6
Thallium	**2.86E-03**	**7.70E-03**	**6.20E-03**	**6.61E-02**	**4.70E-03**	**7.70E-03**	**RME EPC is max detect**	**2 of 6**
Titanium	1.90E-02	4.40E-02	2.10E-03	8.67E+04	NA	4.40E-02	RME EPC is max detect	6 of 6
Vanadium	3.20E-03	8.40E-03	4.30E-03	1.08E+00	NA	8.40E-03	RME EPC is max detect	3 of 6
Zinc	1.20E-01	6.30E-01	2.70E-02	2.01E+02	2.60E+02	6.30E-01	RME EPC is max detect	3 of 6

POND SURFACE WATER (DISSOLVED METALS)

Chemicals of Interest*	Average	Max Detection	Min Detection	$^{Tot}RW_{comb}$ (1)	^{SW}RBELs Saltwater Fish Only (1)	RME EPC	Statistic Used	# of Detects/# of Samples
Antimony	3.50E-03	6.30E-03	3.10E-03	1.99E-01	6.40E+00	6.30E-03	RME EPC is max detect	3 of 6
Barium	1.25E-01	1.30E-01	1.20E-01	6.49E+01	NA	1.30E-01	RME EPC is max detect	6 of 6
Boron	2.79E+00	3.33E+00	2.36E+00	7.44E+01	---	3.33E+00	RME EPC is max detect	6 of 6
Lithium	1.45E-01	2.20E-01	8.00E-02	1.65E+01	NA	2.20E-01	RME EPC is max detect	6 of 6
Manganese	**4.65E-01**	**1.06E+00**	**6.60E-02**	**4.09E+01**	**1.00E+00**	**1.06E+00**	**RME EPC is max detect**	**6 of 6**
Molybdenum	1.01E-02	1.90E-02	1.80E-02	3.47E+00	NA	1.90E-02	RME EPC is max detect	3 of 6
Nickel	1.43E-03	2.60E-03	1.90E-03	1.13E+01	4.60E+01	2.60E-03	RME EPC is max detect	3 of 6
Silver	1.83E-03	2.90E-03	9.40E-04	1.57E+00	NA	2.90E-03	RME EPC is max detect	6 of 6
Strontium	4.32E+00	6.97E+00	1.78E+00	3.38E+02	NA	6.97E+00	RME EPC is max detect	6 of 6
Thallium	1.53E-03	3.20E-03	1.40E-03	6.61E-02	4.70E-03	3.20E-03	RME EPC is max detect	3 of 6
Vanadium	7.58E-04	2.10E-03	2.10E-03	1.08E+00	NA	2.10E-03	RME EPC is max detect	1 of 6

Notes:
*The maximum detected value is sometimes lower than the average since 1/2 of the reporting limit was used as a proxy value when it was not detected, and because J flag data were used in the risk assessment.
* Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.
(1) - TRRP 24. TCEQ, March 31, 2006.
(2) RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 13
EXPOSURE POINT CONCENTATIONS (mg/kg)
WETLAND SEDIMENT

Chemical of Interest[+]	Average	Max Detection	Min Detection	$^{Tot}Sed_{Comb}$[(1)]		95% UCL	Statistic Used [(2)]	# of Detects/# of Samples
1,2-Dichloroethane	1.85E-03	2.40E-03	1.83E-03	6.0E+02	<	1.50E-04	median	3 of 48
2-Methylnaphthalene	2.25E-02	4.30E-01	1.22E-02	4.9E+02	<	1.20E-02	median	4 of 48
4,4'-DDT	1.39E-03	9.22E-03	9.29E-04	8.7E+01		2.52E-03	97.5% KM (Chebyshev)	16 of 55
Acenaphthene	2.13E-02	1.33E-01	1.60E-02	7.4E+03	<	1.11E-02	median	4 of 48
Acenaphthylene	4.88E-02	5.45E-01	2.91E-02	7.4E+03	<	1.27E-02	median	4 of 48
Aluminum	**1.32E+04**	**1.82E+04**	**3.40E+03**	**1.5E+05**		**1.40E+04**	**95% Student's-t**	**48 of 48**
Anthracene	2.99E-02	3.34E-01	8.38E-03	3.7E+04		9.70E-02	97.5% KM (Chebyshev)	8 of 48
Antimony[(3)]	1.24E+00	4.24E+00	4.60E-01	8.3E+01		1.80E+00	97.5% KM (Chebyshev)	40 of 48
Arsenic	**2.78E+00**	**1.28E+01**	**1.00E+00**	**1.1E+02**		**4.81E+00**	**97.5% KM (Chebyshev)**	**35 of 48**
Barium	1.52E+02	8.20E+02	3.60E+01	2.3E+04		2.38E+02	95% Chebyshev	48 of 48
Benzo(a)anthracene	9.20E-02	9.93E-01	5.46E-02	1.6E+01	<	1.14E-02	median	5 of 48
Benzo(a)pyrene	**1.10E-01**	**1.30E+00**	**1.76E-02**	**1.6E+00**		**3.47E-01**	**97.5% KM (Chebyshev)**	**15 of 48**
Benzo(b)fluoranthene	9.23E-02	1.36E+00	1.62E-02	1.6E+01		1.59E-01	95% KM (BCA)	19 of 48
Benzo(g,h,i)perylene	2.06E-01	1.94E+00	4.40E-02	3.7E+03		4.49E-01	95% KM (Chebyshev)	24 of 48
Benzo(k)fluoranthene	1.01E-01	7.30E-01	6.92E-02	1.6E+02		1.31E-01	95% KM (Bootstrap)	14 of 48
Beryllium	8.94E-01	1.37E+00	2.80E-01	2.7E+01		9.43E-01	95% Student's-t	48 of 48
Boron[(3)]	1.53E+01	4.62E+01	5.17E+00	1.1E+05		2.61E+01	97.5% KM (Chebyshev)	24 of 48
Cadmium	1.16E-01	4.80E-01	3.30E-02	1.1E+03		2.42E-01	97.5% KM (Chebyshev)	20 of 48
Carbazole	2.12E-02	1.41E-01	1.58E-02	7.1E+02	<	1.10E-02	median	5 of 48
Carbon Disulfide	3.48E-03	6.99E-03	3.34E-03	7.3E+04	<	1.40E-04	median	4 of 48
Chromium	1.51E+01	4.46E+01	8.96E+00	3.6E+04		1.64E+01	95% Student's-t	48 of 48
Chromium VI	1.63E+00	4.04E+00	1.30E+00	1.4E+02	<	5.67E-01	median	6 of 25
Chrysene	2.15E-01	4.05E+00	1.10E-02	1.6E+03		8.71E-01	97.5% KM (Chebyshev)	19 of 48
Cobalt	6.98E+00	9.89E+00	3.00E+00	3.2E+04		7.32E+00	95% Student's-t	48 of 48
Copper	1.45E+01	4.90E+01	5.44E+00	2.1E+04		2.21E+01	97.5% KM (Chebyshev)	48 of 48
Dibenz(a,h)anthracene	**2.87E-01**	**2.91E+00**	**1.29E-01**	**1.6E+00**	**<**	**3.75E-02**	**median**	**6 of 48**
Dibenzofuran	1.29E-02	8.00E-02	1.00E-02	6.1E+02	<	1.56E-02	median	3 of 48
Endosulfan Sulfate	8.46E-03	6.00E-02	7.31E-03	9.2E+02	<	4.40E-04	median	3 of 48
Endrin Aldehyde	1.28E-03	1.00E-02	5.66E-04	4.6E+01		3.32E-03	97.5% KM (Chebyshev)	9 of 48
Endrin Ketone	3.55E-03	1.30E-02	3.29E-03	4.6E+01	<	5.50E-04	median	3 of 48
Fluoranthene	1.04E-01	2.17E+00	1.20E-02	4.9E+03		4.46E-01	97.5% KM (Chebyshev)	13 of 48
Fluorene	2.17E-02	1.39E-01	1.50E-02	4.9E+03	<	1.10E-02	median	4 of 48
gamma-Chlordane	8.77E-04	3.60E-03	7.69E-04	4.1E+01	<	4.40E-04	median	4 of 48
Indeno(1,2,3-cd)pyrene	**2.20E-01**	**1.94E+00**	**6.28E-02**	**1.6E+01**		**3.17E-01**	**95% KM (BCA)**	**23 of 48**
Iron	1.72E+04	6.09E+04	1.11E+04	---		1.88E+04	95% Student's-t	48 of 48
Lead	**2.54E+01**	**2.37E+02**	**9.40E+00**	**5.0E+02**		**4.68E+01**	**95% Chebyshev**	**48 of 48**
Lithium	1.87E+01	2.76E+01	5.43E+00	1.1E+04		1.96E+01	95% Student's-t	48 of 48
Manganese	3.32E+02	1.01E+03	8.76E+01	1.4E+04		5.17E+02	97.5% Chebyshev	48 of 48
Mercury	2.04E-02	8.10E-02	6.10E-03	3.4E+01		3.80E-02	97.5% KM (Chebyshev)	26 of 48
Molybdenum	5.99E-01	3.24E+00	1.30E-01	1.8E+03		1.20E+00	97.5% KM (Chebyshev)	38 of 48
Nickel	1.73E+01	2.77E+01	1.09E+01	1.4E+03		1.81E+01	95% Student's-t	48 of 48
Phenanthrene	8.46E-02	1.30E+00	2.30E-02	3.7E+03		1.56E-01	95% KM (BCA)	12 of 48
Pyrene	1.52E-01	1.64E+00	1.59E-02	3.7E+03		4.77E-01	97.5% KM (Chebyshev)	19 of 48
Strontium	6.70E+01	3.30E+02	1.88E+01	1.5E+05		1.15E+02	97.5% KM (Chebyshev)	48 of 48
Tin[(3)]	6.38E-01	4.61E+00	3.45E+00	9.2E+04		1.26E+00	95% Chebyshev	4 of 48
Titanium	2.91E+01	6.87E+01	8.15E+00	1.0E+06		4.17E+01	97.5% Chebyshev	48 of 48
Toluene	1.58E-03	2.14E-03	1.57E-03	5.9E+04	<	7.30E-04	median	3 of 48
Vanadium	2.17E+01	3.20E+01	9.02E+00	3.3E+02		2.28E+01	95% Student's-t	48 of 48
Zinc	1.39E+02	9.03E+02	3.15E+01	7.6E+04		2.36E+02	95% Chebyshev	53 of 53

Notes:

[+] Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

[(1)] - $^{Tot}Sed_{Comb}$ PCL = TCEQ Protective Concentration Level for total sediment combined pathway (includes inhalation; ingestion; dermal pathways).

[(2)] - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

[(3)] - Samples 2WSED8, SWSED10, 4WSED2, and 4WSED3 were re-analyzed for antimony, boron, and tin because theinitial data indicated concentrations much higher than data for the rest of the samples although QA/QC indicated that they were acceptable. The re-analysis was run twice with good concurrence between the two re-analyses but with very different values from the original so the first re-analyzed value was used in the UCL calculation.

TABLE 14
EXPOSURE POINT CONCENTATIONS (mg/kg)
POND SEDIMENT

Chemical of Interest[+]	Average	Max Detection	Min Detection	$^{Tot}Sed_{Comb}$ [(1)]		RME EPC	Statistic Used [(2)]	# of Detects/# of Samples
2,4,6-Trichlorophenol	4.29E-02	4.29E-02	4.29E-02	1.3E+03	<	2.69E-02	median	1 of 8
4,4'-DDD	6.76E-04	6.76E-04	6.76E-04	1.2E+02	<	2.00E-02	median	1 of 8
4,4'-DDT	1.27E-03	1.57E-03	1.11E-03	8.7E+01	<	1.10E-02	median	3 of 8
Acetone	7.98E-02	7.98E-02	7.98E-02	6.6E+05	<	4.25E-02	median	1 of 8
Aluminum	**1.17E+04**	**1.63E+04**	**7.99E+03**	**1.5E+05**		**1.40E+04**	**95% Student's-t**	**8 of 8**
Antimony	1.41E+00	1.85E+00	3.30E-01	8.3E+01	<	4.40E-01	median	8 of 8
Arsenic	3.76E+00	5.01E+00	3.39E+00	1.1E+02	<	3.35E-01	median	3 of 8
Barium	1.99E+02	4.17E+02	1.08E+02	2.3E+04		3.83E+02	95% Chebyshev	8 of 8
Benzo(b)fluoranthene	5.37E-02	1.06E-01	2.93E-02	1.6E+01	<	3.38E-02	median	6 of 8
Benzo(g,h,i)perylene	1.35E-01	1.35E-01	1.35E-01	3.7E+03	<	1.59E-02	median	1 of 8
Benzo(k)fluoranthene	1.14E-01	1.30E-01	1.10E-01	1.6E+02	<	2.75E-02	median	3 of 8
Beryllium	8.34E-01	1.13E+00	5.80E-01	2.7E+01		9.72E-01	95% Student's-t	8 of 8
beta-BHC	6.99E-04	6.99E-04	6.99E-04	1.4E+01	<	2.30E-02	median	1 of 8
Boron	1.73E+01	2.84E+01	1.10E+01	1.1E+05	<	1.24E+01	median	5 of 8
Bromomethane	1.61E-02	3.10E-02	1.40E-02	1.0E+03	<	1.35E-02	median	2 of 8
Cadmium	2.13E-01	2.70E-01	1.90E-01	1.1E+03	<	1.90E-01	median	5 of 8
Carbon Disulfide	7.71E-03	7.71E-03	7.71E-03	7.3E+04	<	9.60E-04	median	1 of 8
Chromium	1.29E+01	2.01E+01	8.29E+00	3.6E+04		1.60E+01	95% Student's-t	8 of 8
Chrysene	2.57E-02	2.57E-02	2.57E-02	1.6E+03	<	1.40E-02	median	1 of 8
Cobalt	6.94E+00	8.99E+00	5.19E+00	3.2E+04		7.86E+00	95% Student's-t	8 of 8
Copper	1.52E+01	2.68E+01	8.33E+00	2.1E+04		2.02E+01	95% Student's-t	8 of 8
Iron	1.53E+04	2.01E+04	1.13E+04	---		1.74E+04	95% Student's-t	8 of 8
Lead	1.75E+01	3.05E+01	1.06E+01	5.0E+02		2.23E+01	95% Student's-t	8 of 8
Lithium	1.85E+01	2.37E+01	1.35E+01	1.1E+04		2.12E+01	95% Student's-t	8 of 8
m,p-Cresol	3.75E-02	3.75E-02	3.75E-02	---	<	2.34E-02	median	1 of 8
Manganese	4.88E+02	7.11E+02	3.52E+02	1.4E+04		5.71E+02	95% Student's-t	8 of 8
Methyl Iodide	4.10E-02	4.10E-02	4.10E-02	1.0E+03	<	7.84E-03	median	1 of 8
Molybdenum	2.59E-01	6.00E-01	2.10E-01	1.8E+03	<	1.20E-01	median	2 of 8
Nickel	1.63E+01	2.06E+01	1.23E+01	1.4E+03		1.84E+01	95% Student's-t	8 of 8
Pyrene	2.13E-02	2.65E-02	2.01E-02	3.7E+03	<	1.96E-02	median	3 of 8
Strontium	1.04E+02	1.81E+02	6.33E+01	1.5E+05		1.32E+02	95% Student's-t	8 of 8
Titanium	3.00E+01	4.05E+01	1.91E+01	1.0E+06		3.54E+01	95% Student's-t	8 of 8
Vanadium	2.18E+01	2.74E+01	1.68E+01	3.3E+02		2.46E+01	95% Student's-t	8 of 8
Zinc	3.32E+02	9.99E+02	3.82E+01	7.6E+04		9.61E+02	95% Chebyshev	8 of 8

Notes:

[+] Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

(1) - $^{Tot}Sed_{Comb}$ PCL = TCEQ Protective Concentration Level for total sediment combined pathway (includes inhalation; ingestion; dermal pathways).

(2) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 15
EXPOSURE POINT CONCENTRATIONS (mg/kg)
BACKGROUND SOIL+

Chemical of Interest++	Average	Max Detection	Min Detection	$^{Tot}Soil_{Comb}$ (1)	EPA Region 6 Soil Screening Criteria(2)		95% UCL	Statistic Used (3)	# of Detects/# of Samples
Antimony	1.62E+00	2.19E+00	2.50E-01	3.06E+02	4.50E+02	<	8.90E-01	median	5 of 10
Arsenic	**3.44E+00**	**5.90E+00**	**2.40E-01**	**1.96E+02**	**1.80E+00**		**4.48E+00**	**95% Winsor's-t**	**10 of 10**
Barium	3.33E+02	1.13E+03	1.50E+02	8.90E+04	7.90E+04		9.02E+02	97.5% Chebyshev	10 of 10
Benzo(a)anthracene	8.20E-02	8.20E-02	8.20E-02	2.36E+01	2.30E+00	<	7.61E-03	median	1 of 10
Benzo(a)pyrene	**7.60E-02**	**7.60E-02**	**7.60E-02**	**2.37E+00**	**2.30E-01**	**<**	**1.00E-02**	**median**	**1 of 10**
Benzo(b)fluoranthene	5.70E-02	5.70E-02	5.70E-02	2.36E+01	2.30E+00	<	8.22E-03	median	1 of 10
Benzo(g,h,i)perylene	8.30E-02	8.30E-02	8.30E-02	1.86E+04	---	<	3.50E-02	median	1 of 10
Benzo(k)fluoranthene	1.06E-01	1.06E-01	1.06E-01	2.37E+02	2.30E+01	<	1.15E-02	median	1 of 10
Cadmium	8.30E-02	1.10E-01	4.10E-02	8.52E+02	5.60E+02	<	1.90E-02	median	3 of 10
Carbazole	1.10E-02	1.10E-02	1.10E-02	9.54E+02	9.60E+01	<	8.86E-03	median	1 of 10
Chromium	1.52E+01	2.01E+01	1.07E+01	5.70E+04	5.00E+02		1.70E+01	95% Student's-t	10 of 10
Chrysene	8.30E-02	8.30E-02	8.30E-02	2.40E+03	2.30E+02	<	1.40E-02	median	1 of 10
Copper	1.21E+01	1.93E+01	7.68E+00	3.70E+04	4.20E+04		1.44E+01	95% Student's-t	10 of 10
Fluoranthene	1.56E-01	1.56E-01	1.56E-01	2.48E+04	2.40E+04	<	1.15E-02	median	1 of 10
Indeno(1,2,3-cd)pyrene	**4.17E-01**	**4.17E-01**	**4.17E-01**	**2.37E+01**	**2.30E+00**	**<**	**2.95E-02**	**median**	**1 of 10**
Lead	1.34E+01	1.52E+01	1.10E+01	1.60E+03	8.00E+02		1.43E+01	95% Student's-t	10 of 10
Lithium	2.11E+01	3.25E+01	1.44E+01	1.90E+03	2.30E+04		2.41E+01	95% Student's-t	10 of 10
Manganese	3.77E+02	5.51E+02	2.84E+02	2.41E+04	3.50E+04		5.07E+02	95% Chebyshev	10 of 10
Mercury	2.13E-02	3.00E-02	1.50E-02	3.26E+00	3.40E+02		2.41E-02	95% Student's-t	10 of 10
Molybdenum	5.22E-01	6.80E-01	4.20E-01	4.51E+03	5.70E+03		5.65E-01	95% Student's-t	10 of 10
Phenanthrene	1.37E-01	1.37E-01	1.37E-01	1.86E+04	---	<	6.72E-03	median	1 of 10
Pyrene	1.27E-01	1.27E-01	1.27E-01	1.86E+04	3.20E+04	<	2.00E-02	median	1 of 10
Zinc	2.47E+02	9.69E+02	3.66E+01	2.45E+05	1.00E+05		7.50E+02	95% Chebyshev	10 of 10

Notes:
+ Soil was collected from 0 to 4 ft. below ground surface.
++ Chemicals of interest are any chemical measured in at least one sample. Bolded compounds have a maximum concentration that exceeded one-tenth of the screening value.

(1) - $^{Tot}Soil_{Comb}$ PCL = TCEQ Protective Concentration Level for 30 acre source area Commercial/Industrial total soil combined pathway (includes inhalation; ingestion; dermal pathways).
(2) - From EPA's "Region 6 Human Health Medium-Specific Screening Levels 2004-2005". Industrial Outdoor Worker.
(3) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 16
QUALITATIVE CURRENT OFF-SITE RESIDENTIAL RECEPTOR EVALUATION
SOUTH AREA SOIL*

Chemical of Interest[+]	Average	Max Detection	Min Detection	$^{Air}Soil_{Inh\text{-}VP}$ [(1)]	95% UCL	Statistic Used [(3)]	# of Detects/# of Samples
1,3,5-Trimethylbenzene	9.89E-02	4.36E+00	2.67E-04	6.00E+01	5.56E-01	97.5% KM (Chebyshev)	9 of 83
2-Butanone	3.29E-03	2.26E-02	9.92E-04	5.90E+04	4.14E-03	95% KM (Bootstrap)	4 of 83
2-Hexanone	1.65E-03	2.07E-02	1.09E-03	5.70E+01	3.63E-02	97.5% KM (Chebyshev)	8 of 83
2-Methylnaphthalene	6.97E-02	7.21E+00	1.06E-02	---	1.60E-01	95% KM (BCA)	32 of 166
4,4'-DDD	7.76E-03	1.12E+00	3.69E-04	---	5.08E-02	97.5% KM (Chebyshev)	21 of 166
4,4'-DDE	1.58E-03	6.93E-02	4.28E-04	---	2.81E-03	95% KM (BCA)	22 of 166
4,4'-DDT	3.75E-03	1.13E-01	2.81E-04	6.20E+02	9.27E-03	97.5% KM (Chebyshev)	68 of 166
Acenaphthene	4.33E-02	1.69E+00	1.13E-02	---	1.16E-01	97.5% KM (Chebyshev)	35 of 166
Acenaphthylene	4.84E-02	1.20E+00	1.72E-02	---	7.19E-02	95% KM (BCA)	37 of 166
Acetone	3.70E-02	1.60E-01	3.10E-02	5.80E+03	5.41E-02	97.5% KM (Chebyshev)	10 of 83
Aluminum	6.45E+03	1.57E+04	4.14E+02	2.60E+06	8.20E+03	97.5% Chebyshev	166 of 166
Anthracene	8.89E-02	2.46E+00	1.12E-02	---	1.24E-01	95% KM (BCA)	65 of 166
Antimony	1.45E+00	5.51E+00	2.00E-01	2.50E+05	1.87E+00	97.5% KM (Chebyshev)	144 of 166
Aroclor-1254	**2.16E-01**	**1.15E+01**	**3.34E-03**	**2.80E+00**	**7.73E-01**	**97.5% KM (Chebyshev)**	**25 of 170**
Arsenic	3.33E+00	2.43E+01	2.30E-01	2.70E+03	4.92E+00	97.5% KM (Chebyshev)	139 of 166
Barium	2.37E+02	2.18E+03	1.86E+01	2.50E+05	3.30E+02	95% Chebyshev	166 of 166
Benzene	3.89E-03	2.21E-02	3.39E-04	8.40E+01	6.09E-03	97.5% KM (Chebyshev)	72 of 83
Benzo(a)anthracene	2.69E-01	5.02E+00	1.18E-02	1.90E+03	6.43E-01	97.5% KM (Chebyshev)	44 of 166
Benzo(a)pyrene	3.48E-01	4.88E+00	9.99E-03	4.40E+02	7.63E-01	97.5% KM (Chebyshev)	113 of 166
Benzo(b)fluoranthene	4.77E-01	5.97E+00	4.08E-02	3.20E+03	8.22E-01	95% KM (Chebyshev)	102 of 166
Benzo(g,h,i)perylene	2.17E-01	4.24E+00	9.89E-03	---	4.94E-01	97.5% KM (Chebyshev)	81 of 166
Benzo(k)fluoranthene	1.58E-01	4.25E+00	1.58E-02	7.80E+04	3.81E-01	97.5% KM (Chebyshev)	45 of 166
Beryllium	4.65E-01	4.60E+00	1.40E-02	4.80E+03	5.25E-01	95% KM (BCA)	165 of 166
Boron	5.68E+00	5.44E+01	2.43E+00	1.00E+07	6.51E+00	95% KM (Bootstrap)	72 of 166
Butyl Benzyl Phthalate	2.01E-02	6.17E-01	1.29E-02	1.30E+04	4.72E-02	97.5% KM (Chebyshev)	10 of 166
Cadmium	3.40E-01	9.71E+00	2.30E-02	6.50E+03	4.67E-01	95% KM (Bootstrap)	93 of 166
Carbazole	4.64E-02	1.54E+00	1.04E-02	---	1.19E-01	97.5% KM (Chebyshev)	42 of 166
Carbon Disulfide	1.67E-03	2.80E-02	9.87E-04	5.50E+03	3.92E-03	97.5% KM (Chebyshev)	13 of 83
Chromium	1.35E+01	1.36E+02	2.03E+00	5.00E+04	1.78E+01	95% Chebyshev	166 of 166
Chrysene	3.28E-01	4.87E+00	9.01E-03	3.00E+05	7.12E-01	97.5% KM (Chebyshev)	93 of 166
Cobalt	4.11E+00	1.60E+01	4.90E-02	1.30E+03	4.35E+00	95% Winsor-t	165 of 166
Copper	2.43E+01	4.87E+02	1.30E-01	5.00E+05	4.01E+01	95% KM (Chebyshev)	164 of 166
Cyclohexane	2.65E-01	2.17E+01	6.26E-04	4.70E+04	1.91E+00	97.5% KM (Chebyshev)	47 of 83
Dibenz(a,h)anthracene	1.48E-01	1.64E+00	6.19E-02	1.00E+03	1.80E-01	95% KM (Bootstrap)	56 of 166
Dibenzofuran	3.34E-02	8.21E-01	1.67E-02	---	7.31E-02	97.5% KM (Chebyshev)	23 of 166
Dieldrin	8.89E-04	2.05E-02	2.43E-04	1.60E+01	2.11E-03	97.5% KM (Chebyshev)	33 of 166
Di-n-butyl Phthalate	4.18E-02	7.53E-01	3.11E-02	1.50E+04	7.65E-02	97.5% KM (Chebyshev)	11 of 166
Endosulfan Sulfate	1.27E-03	7.13E-02	7.13E-02	---	2.30E-03	95% KM (BCA)	21 of 166
Endrin Aldehyde	2.01E-03	7.38E-02	4.97E-04	---	3.54E-03	95% KM (BCA)	31 of 166
Endrin Ketone	1.35E-03	2.00E-02	4.69E-04	9.70E+02	2.53E-03	97.5% KM (Chebyshev)	25 of 166
Ethylbenzene	3.40E-03	1.05E-01	6.54E-04	7.90E+03	5.91E-03	95% KM (Bootstrap)	47 of 83
Fluoranthene	5.95E-01	1.42E+01	1.33E-02	---	1.41E+00	97.5% KM (Chebyshev)	96 of 166
Fluorene	4.44E-02	1.11E+00	9.45E-03	---	1.07E-01	97.5% KM (Chebyshev)	41 of 166
gamma-Chlordane	9.98E-04	1.56E-02	7.10E-04	5.00E+02	1.84E-03	97.5% KM (Chebyshev)	12 of 166
Indeno(1,2,3-cd)pyrene	3.85E-01	6.49E+00	5.74E-02	1.30E+04	6.58E-01	95% KM (Chebyshev)	104 of 166
Iron	1.43E+04	7.71E+04	2.41E+03	---	1.75E+04	95% Chebyshev	166 of 166
Isopropylbenzene (cumene)	8.31E-01	6.49E+01	3.18E-04	4.80E+03	5.85E+00	97.5% KM (Chebyshev)	16 of 83
Lead	5.35E+01	7.02E+02	2.48E+00	---	1.04E+02	97.5% Chebyshev	166 of 166
Lithium	1.00E+01	2.86E+01	6.50E-01	---	1.22E+01	95% Chebyshev	166 of 166
m,p-Xylene	3.43E-02	2.56E+00	5.58E-04	4.80E+03	1.69E-01	95% KM (Chebyshev)	53 of 83
Manganese	2.61E+02	8.92E+02	5.93E+01	2.50E+04	2.78E+02	95% Student's-t	166 of 166
Mercury	2.56E-02	8.50E-01	2.60E-03	2.40E+00	4.00E-02	95%KM (BCA)	73 of 166
Methylcyclohexane	3.66E-02	2.73E+00	2.23E-04	2.40E+04	1.80E-01	95% KM (Chebyshev)	57 of 83
Molybdenum	9.05E-01	1.04E+01	8.80E-02	2.50E+06	1.62E+00	97.5% KM (Chebyshev)	118 of 166
Naphthalene	**3.26E-01**	**1.92E+01**	**4.82E-03**	**1.40E+02**	**2.65E-03**	**median**	**8 of 83**
Nickel	1.17E+01	3.67E+01	2.70E+00	2.40E+04	1.24E+01	95% Student's-t	166 of 166
n-Propylbenzene	2.37E-02	1.80E+00	2.30E-04	3.30E+03	1.63E-01	97.5% KM (Chebyshev)	14 of 83
o-Xylene	1.30E-02	8.40E-01	2.23E-04	5.80E+03	7.75E-02	97.5% KM (Chebyshev)	32 of 83
Phenanthrene	4.02E-01	1.26E+01	1.36E-02	---	9.99E-01	97.5% KM (Chebyshev)	95 of 166
Pyrene	4.32E-01	8.47E+00	1.21E-02	---	9.71E-01	97.5% KM (Chebyshev)	98 of 166
Strontium	7.56E+01	5.91E+02	1.65E+01	---	1.01E+02	95% Chebyshev	166 of 166
Tin	8.11E-01	6.48E+00	5.20E-01	1.00E+07	1.20E+00	97.5% KM (Chebyshev)	40 of 166
Titanium	2.58E+01	6.45E+02	4.02E+00	---	3.22E+01	95% Student's-t	166 of 166
Toluene	3.99E-03	1.92E-02	7.21E-04	3.20E+04	6.04E-03	97.5% KM (Chebyshev)	69 of 83
Vanadium	1.44E+01	4.56E+01	4.73E+00	2.50E+04	1.73E+01	97.5% Chebyshev	166 of 166
Xylene (total)	4.73E-02	3.40E+00	7.77E-04	4.80E+03	3.04E-01	97.5% KM (Chebyshev)	53 of 83
Zinc	4.34E+02	7.65E+03	6.17E+00	---	8.15E+02	97.5% Chebyshev	166 of 166

Notes:
* Soil was collected from 0 to 4 ft. below ground surface.
[+] Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent.
(1) - $^{Air}Soil_{Inh\text{-}VP}$ PCL = TCEQ protective concentration Level for 30 acre source area Residential soil-to-air pathway (inhalation of volatiles and particulates).
(2) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 17
QUALITATIVE CURRENT OFF-SITE RESIDENTIAL RECEPTOR EVALUATION
NORTH AREA SOIL*

Chemical of Interest++	Average	Max Detection	Min Detection	$^{Air}Soil_{Inh-VP}$ (1)	95% UCL	Statistic Used (2)	# of Detects/# of Samples
1,1-Dichloroethane	2.67E-02	5.18E-01	1.61E-03	3.20E+03	1.75E-04	median	3 of 19
1,1-Dichloroethene	1.73E-02	3.13E-01	1.78E-03	2.70E+03	3.95E-04	median	2 of 19
1,2-Dichloroethane	1.95E-02	1.77E-01	2.31E-03	7.10E+00	1.27E-04	median	4 of 19
2-Butanone	1.32E-02	2.08E-01	1.70E-03	5.90E+04	7.87E-02	97.5% KM (Chebyshev)	11 of 19
2-Methylnaphthalene	4.05E-02	5.30E-02	1.00E-02	---	1.19E-02	median	4 of 38
4,4'-DDE	2.50E-03	1.49E-02	2.16E-03	---	4.28E-04	median	2 of 38
4,4'-DDT	1.16E-02	1.08E-02	5.97E-04	6.20E+02	7.94E-02	97.5% KM (Chebyshev)	7 of 38
Acenaphthene	1.99E-02	1.57E-01	2.10E-02	---	1.11E-02	median	4 of 38
Aluminum	1.23E+04	1.83E+04	1.81E+03	2.60E+06	1.33E+04	95% Student's-t	38 of 38
Anthracene	2.90E-02	2.64E-01	8.87E-03	---	8.96E-02	97.5% KM (Chebyshev)	6 of 38
Antimony	1.45E+00	8.09E+00	1.66E+00	2.50E+05	2.45E+00	95% KM (Bootstrap)	16 of 38
Aroclor-1254	1.81E-01	9.38E-02	1.22E-02	2.80E+00	4.30E-03	median	2 of 38
Arsenic	2.44E+00	5.69E+00	5.40E-01	2.70E+03	3.82E+00	97.5% KM (Chebyshev)	32 of 38
Barium	1.41E+02	3.62E+02	4.61E+01	2.50E+05	2.34E+02	97.5% Chebyshev	38 of 38
Benzene	2.92E-03	6.32E-03	1.38E-03	8.40E+01	5.39E-03	97.5% KM (Chebyshev)	12 of 18
Benzo(a)anthracene	1.09E-01	1.18E+00	3.83E-02	1.90E+03	1.11E-02	median	4 of 38
Benzo(a)pyrene	9.37E-02	1.42E+00	1.35E-02	4.40E+02	3.78E-01	97.5% KM (Chebyshev)	10 of 38
Benzo(b)fluoranthene	1.44E-01	1.62E+00	4.87E-02	3.20E+03	2.52E-01	95% KM (Bootstrap)	11 of 38
Benzo(g,h,i)perylene	1.03E-01	1.28E+00	2.37E-02	---	3.42E-01	97.5% KM (Chebyshev)	14 of 38
Benzo(k)fluoranthene	1.07E-01	7.99E-01	6.80E-02	7.80E+04	1.72E-02	median	6 of 38
Beryllium	7.15E-01	2.88E+00	6.60E-02	4.80E+03	1.18E+00	97.5% KM (Chebyshev)	35 of 38
Bis(2-ethylhexyl)phthalate	4.12E-02	2.39E-01	1.22E-02	---	9.96E-02	97.5% KM (Chebyshev)	11 of 38
Boron	7.64E+00	3.92E+01	3.14E+00	1.00E+07	1.71E+01	97.5% KM (Chebyshev)	26 of 38
Bromoform	1.14E-02	1.80E-02	1.10E-02	4.30E+02	1.86E-04	median	2 of 19
Butyl Benzyl Phthalate	5.66E-02	1.51E-01	5.40E-02	1.30E+04	1.36E-02	median	2 of 38
Cadmium	3.63E-01	8.00E-01	2.80E-01	6.50E+03	5.19E-01	97.5% KM (Chebyshev)	15 of 38
Carbazole	1.74E-02	1.28E-01	1.08E-02	---	1.10E-02	median	7 of 38
Carbon Disulfide	8.64E-03	2.84E-02	7.57E-03	5.50E+03	1.19E-04	median	3 of 19
Chromium	1.83E+01	1.28E+02	7.76E+00	5.00E+04	3.21E+01	95% Chebyshev	38 of 38
Chrysene	1.03E-01	1.30E+00	1.04E-02	3.00E+05	3.84E-01	97.5% KM (Chebyshev)	11 of 38
cis-1,2-Dichloroethene	6.61E-02	9.99E-01	1.95E-02	6.30E+03	1.38E-04	median	2 of 19
Cobalt	6.52E+00	1.03E+01	2.81E+00	1.30E+03	7.04E+00	95% Student's-t	38 of 38
Copper	6.56E+01	2.00E+02	4.59E+00	5.00E+05	5.12E+02	99% Chebyshev	38 of 38
Cyclohexane	1.13E-03	1.85E-03	9.81E-04	4.70E+04	1.25E-03	median	5 of 19
Dibenz(a,h)anthracene	6.88E-02	4.04E-01	4.50E-02	1.00E+03	1.08E-02	median	7 of 38
Dibenzofuran	1.96E-02	8.62E-02	1.50E-02	---	1.50E-02	median	2 of 38
Diethyl Phthalate	1.01E-02	1.10E-02	9.92E-03	---	1.85E-02	median	2 of 38
Di-n-butyl Phthalate	1.05E-02	1.50E-02	1.00E-02	1.50E+04	3.07E-02	median	2 of 38
Di-n-octyl Phthalate	1.90E-02	1.23E-01	1.54E-02	---	9.52E-03	median	3 of 38
Ethylbenzene	2.69E-03	5.02E-03	1.14E-03	7.90E+03	1.14E-03	median	5 of 19
Fluoranthene	1.44E-01	2.19E+00	2.14E-02	---	6.24E-01	97.5% KM (Chebyshev)	9 of 38
Fluorene	5.27E-02	1.41E-01	1.70E-02	---	3.92E-04	median	4 of 38
Indeno(1,2,3-cd)pyrene	1.15E-01	1.51E+00	2.00E-02	1.30E+04	3.96E-01	97.5% KM (Chebyshev)	13 of 38
Iron	2.09E+04	1.02E+05	7.12E+03	---	3.69E+04	95% Chebyshev	38 of 38
Lead	5.30E+01	5.83E+00	6.30E+02	---	2.48E+02	99% Chebyshev	34 of 38
Lithium	1.92E+01	3.22E+01	2.59E+00	---	2.08E+01	95% Student's-t	36 of 38
m,p-xylene	1.32E-03	1.39E-03	1.32E-03	4.80E+03	4.22E-04	median	2 of 19
Manganese	3.87E+02	1.21E+03	8.23E+01	2.50E+04	6.39E+02	97.5% Chebyshev	38 of 38
Mercury	1.43E-02	1.70E-01	3.40E-03	2.40E+00	4.38E-02	97.5% KM (Chebyshev)	15 of 38
Methylcyclohexane	1.76E-03	2.78E-03	1.50E-03	2.40E+04	1.54E-03	median	6 of 19
Molybdenum	1.40E-01	1.07E+01	8.50E-02	2.50E+06	2.49E+00	97.5% KM (Chebyshev)	21 of 38
Naphthalene	3.24E+00	1.48E-01	1.30E-03	1.40E+02	3.70E-03	median	6 of 19
Nickel	1.80E+01	5.17E+01	9.74E+00	2.40E+04	2.01E+01	95% Student's-t	38 of 38
Phenanthrene	1.50E-01	1.83E+00	1.80E-02	---	5.70E-01	97.5% KM (Chebyshev)	12 of 38
Pyrene	2.62E-01	4.64E+00	1.49E-02	---	1.12E+00	97.5% KM (Chebyshev)	14 of 38
Silver	1.05E-01	4.10E-01	9.20E-02	5.00E+03	5.90E-02	median	3 of 38
Strontium	5.64E+01	9.62E+01	2.21E+01	---	6.20E+01	95% Student's-t	38 of 38
Tetrachloroethene	1.26E-02	2.23E-01	1.35E-03	4.80E+02	2.11E-04	median	3 of 19
Tin	5.34E+00	3.67E+00	6.80E-01	1.00E+07	5.70E-01	median	5 of 38
Titanium	2.33E+01	5.70E+01	3.41E+00	---	4.03E+01	97.5% Chebyshev	38 of 38
Toluene	3.24E-03	1.22E-02	1.34E-03	3.20E+04	8.15E-03	97.5% KM (Chebyshev)	8 of 19
Vanadium	2.10E+01	4.58E+01	7.85E+00	2.50E+04	2.33E+01	95% Student's-t	38 of 38
Xylene (total)	1.78E-01	1.76E+00	1.39E-03	4.80E+03	8.58E-01	97.5% KM (Chebyshev)	8 of 19
Zinc	2.83E+02	5.64E+03	2.11E+01	---	1.78E+03	99% Chebyshev	38 of 38

Notes:
+ Soil was collected from 0 to 4 ft. below ground surface.
++ Chemicals of interest are any chemical measured in at least one sample at a frequency of detection greater than five percent. Bolded compounds have a maximum concentration that exceeded the screening value.
(1) - $^{Air}Soil_{Inh-VP}$ PCL = TCEQ protective concentration Level for 30 acre source area Residential soil-to-air pathway (inhalation of volatiles and particulates).

(2) - Recommended exposure point concentration to be used based on data distribution per Pro UCL (see Appendix A).

TABLE 18
BACKGROUND COMPARISONS

HYPOTHESIS TESTED: ARE SITE DATA STATISTICALLY DIFFERENT THAN BACKGROUND DATA?[1]							
CHEMICAL OF INTEREST	**SOUTH AREA SURFACE SOIL**	**SOUTH AREA SOIL**	**NORTH AREA SURFACE SOIL**	**NORTH AREA SOIL**	**INTRACOASTAL WATERWAY SEDIMENT**	**WETLANDS SEDIMENT**	**POND SEDIMENT**
Aluminum	NA	NA	NA	NA	Yes*	NA	NA
Antimony	No	No	No	No	Yes*	No	No
Arsenic	No	No	No	No	Yes*	No	Yes*
Barium	No	No	Yes*	Yes*	No	Yes*	No
Beryllium	NA	NA	NA	NA	Yes*	NA	NA
Boron	NA	NA	NA	NA	Yes*	NA	NA
Cadmium	No	No	**Yes**	Yes*	NA	**Yes**	**Yes**
Chromium	No	No	No	No	NA	No	No
Cobalt	NA	NA	NA	NA	Yes*	NA	NA
Copper	**Yes**	No	No	No	No	No	No
Iron	NA	NA	NA	NA	No	NA	No
Lead	**Yes**	No	No	No	No	No	**Yes**
Lithium	Yes*	Yes*	Yes*	No	Yes*	No	No
Manganese	Yes*	Yes*	No	No	No	No	**Yes**
Mercury	No	No	Yes*	Yes*	No	No	NA
Molybdenum	**Yes**	No	No	No	No	No	Yes*
Nickel	NA	NA	NA	NA	No	NA	NA
Strontium	NA	NA	NA	NA	Yes*	NA	NA
Titanium	NA	NA	NA	NA	Yes*	NA	NA
Vanadium	NA	NA	NA	NA	Yes*	NA	NA
Zinc	**Yes**	No	No	No	No	No	No

Notes:
[1] Detailed statistical procedures are outlined in Section 2.2.2 and calculations are provided in Appendix B.
* Statistical difference is due to background being greater than site.
NA - No analysis was performed for compound in background.

TABLE 19
PCOCS IDENTIFIED AND QUANTITATIVELY EVALUATED IN THE BHHRA*

SOUTH AREA SOIL**	NORTH AREA SOIL**	INTRACOASTAL WATERWAY SURFACE WATER	INTRACOASTAL WATERWAY SEDIMENT	WETLANDS SURFACE WATER	WETLANDS SEDIMENT	POND SURFACE WATER	POND SEDIMENT
4,4'-DDD Aluminum Aroclor-1254 Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Dibenz(a,h)anthracene Dieldrin Indeno(1,2,3-cd)pyrene Iron Isopropylbenzene (cumene) Lead Naphthalene	1,2-Dichloroethane Aluminium Aroclor-1254 Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Iron Tetrachloroethene	none+	Benzo(a)pyrene Dibenz(a,h)anthracene Iron	none+	Aluminum Benzo(a)pyrene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Iron	none+	Aluminum Iron m,p-Cresol

Notes:
* Groundwater was not included in the table because all compounds measured in groundwater were evaluated quantitatively in the BHHRA.
** Soil includes both surface and subsurface soil for the purposes of this table.
+ All COIs for surface water screened out, as discussed in Section 2.2.1.

TABLE 20
EVALUATION OF EXPOSURE PATHWAYS

PATHWAY NAME	POTENTIAL CONTAMINANTS OF CONCERN	SOURCE	POTENTIAL EXPOSURE MEDIA	POTENTIAL POINT OF EXPOSURE	POTENTIALLY EXPOSED POPULATION*	POTENTIAL ROUTE OF EXPOSURE	COMMENTS
South Area Soil	4,4'-DDD, Aluminum, Aroclor-1254, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, Dieldrin, Indeno(1,2,3-cd)pyrene, Iron, Isopropylbenzene (cumene), Lead, Naphthalene	Site Operations	Soil	On-site	Industrial Worker, Construction Worker, Youth Trespasser	Incidental ingestion and dermal contact	Pathways quantitatively evaluated in BHHRA.
			Air	On-site	Industrial Worker, Construction Worker, Youth Trespasser	Inhalation of VOCs and particulates	Pathways quantitatively evaluated in BHHRA.
			Air	Off-site	Off-Site Resident	Inhalation of VOCs and particulates	Pathway screened out as described in Section 2.2.
South Area Groundwater	VOCs	Site Operations	Soil Gas to Indoor Air	On-site	Industrial Worker (future only)	Inhalation of vapors intruding from groundwater	Pathway quantitatively evaluated in BHHRA.
North Area Soil	1,2-Dichloroethane, Aluminum, Aroclor-1254, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Iron, Tetrachloroethene	Site Operations	Soil	On-site	Industrial Worker, Construction Worker, Youth Trespasser	Incidental ingestion and dermal contact	Pathways quantitatively evaluated in BHHRA.
			Air	On-site and Off-site	Industrial Worker, Construction Worker, Youth Trespasser	Inhalation of VOCs and particulates	Pathways quantitatively evaluated in BHHRA.
			Air	Off-site	Off-Site Resident	Inhalation of VOCs and particulates	Pathway screened out as described in Section 2.2.
North Area Groundwater	VOCs	Surface Impoundment	Soil Gas to Indoor Air	On-site	Industrial Worker (future only)	Inhalation of vapors intruding from groundwater	Pathway quantitatively evaluated in BHHRA.
Intracoastal Waterway Sediment	Benzo(a)pyrene, Dibenz(a,h)anthracene, Iron	Runoff from Site	Sediment	Off-site	Contact Recreation	Incidental ingestion and dermal contact	Pathways quantitatively evaluated in BHHRA.
			Fish Uptake	Off-site	Recreational Fisherman	Fish ingestion	Quantitatively evaluated in fish tissue risk assessment.
Intracoastal Waterway Surface Water	COIs screened out as described in Section 2.2.	Runoff from Site	Surface Water	Off-site	Contact Recreation	Incidental ingestion and dermal contact	Pathway screened out as described in Section 2.2.
			Fish Uptake	Off-site	Recreational Fisherman	Fish ingestion	Quantitatively evaluated in fish tissue risk assessment.
North Wetlands Sediment	Aluminum, Benzo(a)pyrene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Iron	Runoff from Site	Sediment	On-site and Off-site	Contact Recreation	Incidental ingestion and dermal contact	Pathways quantitatively evaluated in BHHRA.
North Wetlands Surface Water	COIs screened out as described in Section 2.2.	Runoff from Site	Surface Water	On-site and Off-site	Contact Recreation	Incidental ingestion and dermal contact	Pathway screened out as described in Section 2.2.
Pond Sediment	Aluminum, Iron, m,p-Cresol	Runoff from Site	Sediment	On-site	Contact Recreation	Incidental ingestion and dermal contact	Pathways quantitatively evaluated in BHHRA.
Pond Surface Water	COIs screened out as described in Section 2.2.	Runoff from Site	Surface Water	On-site	Contact Recreation	Incidental ingestion and dermal contact	Pathway screened out as described in Section 2.2.

Notes:
Unless otherwise noted, the timeframe considered was current and future exposure.

TABLE 21
EXPOSURE SCENARIOS BY MEDIA

MEDIA	Future On-Site Industrial Worker Receptor	Future On-Site Construction Worker Receptor	Potential Current Youth Trespasser	Potential Current Contact Recreation	Potential Current Off-Site Residential Receptor
South Area Surface Soil	X [1]	X [1]	X [1]		X [2]
South Area Soil	X [1]	X [1]	X [1]		X [3]
South Area Groundwater	X [6]				
Intracoastal Waterway Surface Water				X [4]	
Intracoastal Waterway Sediment				X [5]	
Intracoastal Waterway Fish					X*
North Area Surface Soil	X [1]	X [1]	X [1]		
North Area Soil	X [1]	X [1]	X [1]		
North Area Groundwater	X [7]				
North Area Wetlands Surface Water		X+	X [12]	X [8]	
North Area Wetlands Sediment		X+	X [12]	X [9]	
North Area Ponds Surface Water		X+	X [12]	X [10]	
North Area Ponds Sediment		X+	X [12]	X [11]	

Notes:
* EPA-approved fish ingestion pathway risk assessment (PBW, 2007) concluded that this pathway does not pose a human health threat.
+ Exposure for this receptor was not quantified since exposure would be approximately four times less than the acceptable risk calculated for the contact recreation receptor. due to the less exposure incurred for the worker given the differences in exposure frequency and duration.
[1] Risks presented in Table 23.
[2] Risks presented in Table 24.
[3] Risks presented in Table 25.
[4] Screening evaluation presented in Table 4.
[5] Screening evaluation presented in Table 6.
[6] Risks presented in Table 26.
[7] Risks presented in Table 27.
[8] Screening evaluation presented in Table 11.
[9] Screening evaluation presented in Table 13.
[10] Screening evaluation presented in Table 12.
[11] Screening evaluation presented in Table 14.
[12] Trespasser risks were assumed to be equivalent to the contact recreation receptor.

TABLE 22
EXPOSURE ASSUMPTIONS FOR THE INDUSTRIAL WORKER SCENARIO

PARAMETER	DEFINITION	AVERAGE VALUE	REFERENCE	RME VALUE	REFERENCE
PEF	Particulate Emission Factor (m^3/kg)	1.00E+09	EPA, 2004a	1.00E+09	EPA, 2004a
IR	Ingestion rate of soil (mg/day)	50	EPA, 2004a	50	EPA, 2004a
SA	Skin surface area (cm2)	3300	EPA, 2004a	3300	EPA, 2004a
AF	Soil to skin adherence factor (mg/cm2)	0.021	EPA, 2001a	0.2	EPA, 2004a
EF	Exposure frequency (day/yr)	250	EPA, 2004a	250	EPA, 2004a
ED	Exposure duration (yr)	25	EPA, 2004a	25	EPA, 2004a
BW	Body weight (kg)	70	EPA, 1989	70	EPA, 1989
ATc	Averaging time for carcinogens (days)	25550	EPA, 1989	25550	EPA, 1989
ATnc	Averaging time for noncarcinogens (days)	9125	EPA, 1989	9125	EPA, 1989

TABLE 23
EXPOSURE ASSUMPTIONS FOR THE CONSTRUCTION WORKER SCENARIO

PARAMETER	DEFINITION	AVERAGE VALUE	REFERENCE	RME VALUE	REFERENCE
PEF	Particulate Emission Factor (m^3/kg)	1.00E+09	EPA, 2004a	1.00E+09	EPA, 2004a
IR	Ingestion rate of soil (mg/day)	165	professional judgment	330	EPA, 2001
SA	Skin surface area (cm2)	3300	EPA, 2004a	3300	EPA, 2004a
AF	Soil to skin adherence factor (mg/cm2)	0.14	EPA, 2004b	0.3	EPA, 2004b
EF	Exposure frequency (day/yr)	90	professional judgment	250	professional judgment
ED	Exposure duration (yr)	1	professional judgment	1	professional judgment
BW	Body weight (kg)	70	EPA, 1989	70	EPA, 1989
ATc	Averaging time for carcinogens (days)	25550	EPA, 1989	25550	EPA, 1989
ATnc	Averaging time for noncarcinogens (days)	365	EPA, 1989	365	EPA, 1989

TABLE 24
EXPOSURE ASSUMPTIONS FOR THE YOUTH TRESPASSER SCENARIO

PARAMETER	DEFINITION	AVERAGE VALUE	REFERENCE	RME VALUE	REFERENCE
PEF	Particulate Emission Factor (m^3/kg)	1.00E+09	EPA, 2004a	1.00E+09	EPA, 2004a
IR	Ingestion rate of soil (mg/day)	100	TNRCC, 1998	100	TNRCC, 1998
SA	Skin surface area (cm2)	3500	TNRCC, 1998	3500	TNRCC, 1998
AF	Soil to skin adherence factor (mg/cm2)	0.1	TNRCC, 1998	0.1	TNRCC, 1998
EF	Exposure frequency (day/yr)	25	professional judgment	50	TNRCC, 1998
ED	Exposure duration (yr)	6	professional judgment	12	TNRCC, 1998
BW	Body weight (kg)	40	EPA, 1991a	40	EPA, 1991a
ATc	Averaging time for carcinogens (days)	25550	EPA, 1989	25550	EPA, 1989
ATnc	Averaging time for noncarcinogens (days)	9125	EPA, 1989	9125	EPA, 1989

TABLE 25
EXPOSURE ASSUMPTIONS FOR THE CONTACT RECREATION SCENARIO

PARAMETER	DEFINITION	AVERAGE VALUE	REFERENCE	RME VALUE	REFERENCE
IR	Ingestion rate of soil or sediment (mg/day)	100	TCEQ, 2002	100	TCEQ, 2002
SA	Skin surface area (cm2)	4400	TCEQ, 2002	4400	TCEQ, 2002
AF	Sediment to skin adherence factor (mg/cm2)	0.3	TCEQ, 2002	0.3	TCEQ, 2002
EF	Exposure frequency (day/yr)	19	professional judgment	39	TCEQ, 2002
ED	Exposure duration (yr)	13	professional judgment	25	EPA, 1989
BW	Body weight (kg)	70	EPA, 1989	70	EPA, 1989
ATc	Averaging time for carcinogens (days)	25550	EPA, 1989	25550	EPA, 1989
ATnc	Averaging time for noncarcinogens (days)	9125	EPA, 1989	9125	EPA, 1989

TABLE 26
JOHNSON AND ETTINGER VAPOR INTRUSTION MODEL OUTPUT FOR SOUTH AREA GROUNDWATER

Potential Chemical of Concern*	Average	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	RME EPC [1]	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1,1,1-Trichloroethane	1.85E-04	NA	3.55E-06	1.40E-03	NA	2.68E-05
1,1-Dichloroethane	2.10E-03	NA	6.23E-05	1.50E-02	NA	4.45E-04
2-Butanone	4.30E-04	NA	1.38E-07	3.00E-03	NA	9.59E-07
2-Methylnaphthalene	7.76E-04	NA	2.73E-05	8.80E-03	NA	3.09E-04
4,4'-DDE	3.34E-06	5.18E-11	NA	1.00E-05	1.55E-10	NA
Acetophenone	3.72E-03	NA	5.91E-06	4.60E-02	NA	7.31E-05
Benzene	4.25E-04	2.38E-08	2.38E-04	4.20E-03	2.36E-07	2.35E-03
Benzo(b)fluoranthene	3.26E-04	2.95E-08	NA	2.80E-03	1.36E-07	NA
Carbon Disulfide	6.50E-05	NA	8.94E-06	3.00E-04	NA	4.13E-05
Chrysene	1.93E-04	1.83E-10	NA	6.00E-04	5.69E-10	NA
cis-1,2-Dichloroethene	3.27E-03	NA	1.07E-03	3.00E-02	NA	9.86E-03
Fluorene	1.84E-04	NA	1.56E-06	1.00E-03	NA	8.48E-06
gamma-BHC (Lindane)	7.66E-06	3.61E-10	2.16E-06	4.20E-05	1.98E-09	1.18E-05
Isopropylbenzene (Cumene)	1.78E-04	NA	1.34E-05	1.60E-03	NA	1.21E-04
Vinyl Chloride	1.85E-04	6.15E-08	1.63E-04	1.90E-03	6.31E-07	1.67E-03
	TOTAL	**1.15E-07**	**1.60E-03**	**TOTAL**	**1.01E-06**	**1.49E-02**

Notes:
* Only volatile compounds were assesses for this pathway.
[1] RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 27
JOHNSON AND ETTINGER VAPOR INTRUSTION MODEL OUTPUT FOR
NORTH AREA GROUNDWATER

Potential Chemical of Concern*+	Average	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	RME EPC [1]	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1,1,1-Trichloroethane	**1.48E+01**	**NA**	**2.84E-01**	**1.56E+02**	**NA**	**2.99E+00**
1,1-Dichloroethane	2.80E+00	NA	8.31E-02	3.15E+01	NA	9.34E-01
1,1-Dichloroethene	**3.46E+00**	**NA**	**1.26E+00**	**2.92E+01**	**NA**	**1.06E+01**
1,2,3-Trichloropropane	**6.17E+00**	**3.83E-03**	**3.19E+00**	**4.43E+01**	**2.75E-02**	**2.29E+01**
1,2,4-Trimethylbenzene	3.80E-02	NA	8.29E-02	4.20E-02	NA	9.16E-02
1,2-Dichloroethane	**2.42E+01**	**1.39E-03**	**NA**	**3.28E+02**	**1.89E-02**	**NA**
1,2-Dichloropropane	**4.90E-01**	**3.46E-05**	**1.04E+00**	**3.45E+00**	**2.43E-04**	**7.32E+00**
2-Methylnaphthalene	2.70E-03	NA	9.49E-05	1.60E-02	NA	5.62E-04
4,4'-DDE	2.14E-05	3.32E-10	NA	2.70E-04	4.19E-09	NA
Acenaphthene	9.00E-04	NA	6.96E-06	8.60E-03	NA	6.65E-05
Acetone	2.81E-01	NA	1.33E-03	1.15E-01	NA	5.45E-04
Acetophenone	6.80E-03	NA	1.08E-05	7.40E-02	NA	1.18E-04
alpha-BHC	1.96E-05	3.66E-09	NA	2.00E-04	3.74E-08	NA
Benzene	**1.02E+00**	**5.72E-05**	**5.70E-01**	**8.24E+00**	**4.62E-04**	**4.61E+00**
Benzo(b)fluoranthene	3.23E-04	2.92E-08	NA	1.40E-03	1.27E-07	NA
Carbon Tetrachloride	**5.60E-01**	**2.63E-04**	**NA**	**7.58E+00**	**3.56E-03**	**NA**
cis-1,2-Dichloroethene	**8.96E+00**	**NA**	**2.94E+00**	**1.24E+02**	**NA**	**4.08E+01**
Dibenzofuran	6.01E-04	NA	1.51E-05	4.90E-03	NA	1.23E-04
Dieldrin	5.01E-06	2.52E-09	7.30E-06	2.64E-05	1.33E-08	3.85E-05
Ethylbenzene	9.69E-02	NA	1.89E-03	7.40E-01	NA	1.44E-02
Fluorene	8.51E-04	NA	7.22E-06	6.10E-03	NA	5.18E-05
gamma-BHC (Lindane)	1.25E-04	5.89E-09	3.53E-05	1.50E-03	7.06E-08	4.23E-04
m,p-Xylene	6.85E-02	NA	1.34E-02	1.68E-01	NA	3.28E-02
Methylene Chloride	**9.57E+01**	**1.77E-04**	**2.91E-01**	**1.23E+03**	**2.27E-03**	**3.74E+00**
Naphthalene	7.83E-02	NA	6.40E-02	3.22E-01	NA	2.63E-01
o-Xylene	4.62E-02	NA	7.26E-03	4.40E-02	NA	6.92E-03
Pyrene	2.23E-04	NA	7.70E-07	5.00E-04	NA	1.73E-06
Styrene	2.60E-02	NA	1.98E-04	2.50E-03	NA	1.91E-05
Tetrachloroethene	**1.95E+00**	**2.05E-04**	**1.35E-01**	**2.05E+01**	**2.15E-03**	**1.42E+00**
Toluene	3.35E-01	NA	1.61E-02	4.05E+00	NA	1.94E-01
Trichloroethene	**1.15E+01**	**1.43E-02**	**7.59E+00**	**8.40E+01**	**1.05E-01**	**5.54E+01**
Vinyl Chloride	**5.02E-01**	**1.67E-04**	**4.42E-01**	**5.09E+00**	**1.69E-03**	**4.49E+00**
	TOTAL	**2.04E-02**	**1.80E+01**	**TOTAL**	**1.61E-01**	**1.56E+02**

Notes:

* Only volatile compounds were assesses for this pathway.

+ Compounds with a cancer risk greater than 1 x 10^{-5} or a hazard index greater than 1 have been bolded.

[1] RME EPC is the reasonable maximim exposure exposure point concentration.

TABLE 28
SUMMARY OF HAZARD INDICES AND CANCER RISK ESTIMATES FOR SOIL AND SEDIMENT EXPOSURE

SOUTH AREA

HYPOTHETICAL ON-SITE RECEPTORS	CARCINOGENIC RISK	NONCARCINOGENIC HAZARD INDEX
Average Youth Trespasser (soil)	9.85E-08	1.79E-03
RME Youth Trespasser (soil)	1.09E-06	1.46E-02
Average Construction Worker (soil)	5.22E-08	2.46E-02
RME Construction Worker (soil)	8.19E-07	2.77E-01
Average Industrial Worker (soil)	9.50E-07	2.01E-02
RME Industrial Worker (soil)	6.08E-06	7.04E-02
Average Industrial Worker (vapor intrusion)	1.15E-07	1.60E-03
RME Industrial Worker (vapor intrusion)	1.01E-06	1.49E-02
TOTAL Average Industrial Worker (soil + vapor intrusion)	1.06E-06	2.17E-02
TOTAL RME Industrial Worker (soil + vapor intrusion)	7.09E-06	8.53E-02
Average Contact Recreation (Intracoastal Waterway Sediment)	4.54E-08	8.35E-04
RME Contact Recreation (Intracoastal Waterway Sediment)	3.40E-08	5.43E-03

NORTH AREA

HYPOTHETICAL ON-SITE RECEPTORS	CARCINOGENIC RISK	NONCARCINOGENIC HAZARD INDEX
Average Youth Trespasser (soil)	2.57E-08	6.21E-03
RME Youth Trespasser (soil)	5.71E-07	2.80E-02
Average Construction Worker (soil)	1.37E-08	8.72E-02
RME Construction Worker (soil)	4.27E-07	5.45E-01
Average Industrial Worker (soil)	2.54E-07	7.34E-02
RME Industrial Worker (soil)	3.20E-06	9.28E-02
Average Industrial Worker (vapor intrusion)	2.04E-02	1.80E+01
RME Industrial Worker (vapor intrusion)	1.61E-01	1.56E+02
TOTAL Average Industrial Worker (soil + vapor intrusion)	2.04E-02	1.81E+01
TOTAL RME Industrial Worker (soil + vapor intrusion)	1.61E-01	1.56E+02
Average Contact Recreation (Wetlands Sediment)	1.09E-07	1.07E-03
RME Contact Recreation (Wetlands Sediment)	4.16E-07	4.65E-03
Average Contact Recreation (Pond Sediment)	---*	6.10E-03
RME Contact Recreation (Pond Sediment)	---*	2.85E-02

Notes:
* None of the COPCs for this media are considered carcinogenic by EPA.